AMERICAN ENGINEER

"THE RAILWAY MECHANICAL MONTHLY"

(Including the Railway Age Gazette "Shop Edition.")

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH, BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY,
83 FULTON STREET, NEW YORK, N. Y.

CHICAGO: Plymouth Bldg. CLEVELAND: Citizen's Bldg.
LONDON: Queen Anne's Chambers, Westminster.

EDWARD A. SIMMONS, *President.* HENRY LEE, *Secretary.*
L. B. SHERMAN, *Vice-President.* A. E. HOOVEN, *Business Manager.*
The address of the company is the address of the officers.

ROY V. WRIGHT, *Editor.* R. E. THAYER, *Associate Editor.*
E. A. AVERILL, *Managing Editor.* WILLIAM FORSYTH, *Associate Editor.*
GEORGE L. FOWLER, *Associate Editor.*

Subscriptions, including the eight daily editions of the *Railway Age Gazette* published in June in connection with the annual conventions of the Master Car Builders' and American Railway Master Mechanics' associations, payable in advance and postage free:

United States, Canada and Mexico.....$2.00 a year
Foreign Countries (excepting daily editions)..... 3.00 a year
Single Copy ..... 20 cents

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

VOLUME 86. JULY, 1912. NUMBER 7.

CONTENTS

EDITORIALS:
Recent Competitions 331
Tool Foremen's Convention 331
Making Piston Packing..... 331
Maintaining Mallet Locomotives..... 331
Engine House Reports and Records..... 332
Criticisms of Shop Practice..... 332
General Foremen's Association 332
Repairing Boiler Tubes 332
Defective Freight Cars 333
Canadian Pacific Mallet 333

COMMUNICATIONS:
Formers for Hydraulic Press 334
Rapairing Locomotive Driving Boxes..... 334

ILLUSTRATED:
Maintaining Mallet Locomotives 335
Shop Kinks, Pennsylvania, Tyrone, Pa..... 338
Engine House Reports and Records..... 339
Shop Kinks, Grand Trunk, Battle Creek, Mich..... 343
Simple Mallet for High Speed..... 347
Central of New Jersey Ice Car..... 353
Ash Pan for Narrow Firebox..... 356
An Ideal Boiler Tube Department..... 357
Car Shop Kinks 361
Articulated Electric Locomotives with Eight Motors..... 363
Locomotive Boiler Low Water Tests..... 366
Repairing Driving Boxes..... 369
Pacific Type Locomotive with Gaines Firebox..... 372
Double Drill with Independent Heads..... 373
Rolled Steel Truck Side Frames..... 375
Automatic Feed for Bolt Header..... 376
Rochester Horizontal Boring Mill..... 376
A Dining Car Without Vestibules..... 378
Variable Lead Attachment on Walschaert Valve Gear..... 379
All-Steel Pilot 380

MISCELLANEOUS:
Efficiency of Railway Employees..... 355
Cutting Speed on Planers..... 366
Gas-Electric Cars for the Frisco..... 379

GENERAL NEWS SECTION:
Notes 381
Meetings and Conventions 382
Personals 382
New Shops 384
Supply Trade Notes 385
Catalogs 386

Recent Competitions

The safety competition, which closed June first, was well supported by our readers. The judges have not yet decided upon the winner, but the decision will be ready in time for publication in our August issue. It is also expected that the announcement of the winners in the shop kink competition, which closed some time ago, will be made at that time. The delay in making this latter decision has been due to the very large number of kinks which were submitted, and the uniformly high quality of the contributions.

Tool Foremen's Convention

The American Railway Tool Foremen's Association will hold its fourth annual convention in Chicago, July 9. Although this organization is quite young its conventions have been fairly well attended and the meetings have been interesting and well conducted, although they have suffered somewhat because of the poorly adapted quarters in which they have been held. This year the convention will meet in the Hotel Sherman, which is much better suited for it. The reports will cover the standardization of steel for small tools, the design and tempering of milling cutters, the care of shop tools, checking systems, and the treating of steel in electric furnaces.

Making Piston Packing

Not the least important feature that will be considered in connection with the shop practice competition on repairing pistons, piston rods and crossheads, which closes September 1, will be the methods employed and the results obtained in the manufacture of piston packing. This is one of the most important jobs in a shop and one on which some shops have made surprising reductions in cost and time by a careful study of the whole operation and by the selection of machine tools best suited for the work. Competitors for the prize of $25 offered in this competition, announced in the June issue, will greatly improve their chances of winning, by giving detailed time studies of the work on each part. Photographs or drawings, or both, are of great assistance in articles of this kind and should accompany the contribution whenever possible.

Maintaining Mallet Locomotives

Properly maintaining articulated locomotives of moderately large size in regular road service has not proved very difficult on the Pennsylvania division of the New York Central. Twenty-six of these engines have been in service for over a year, and at the present time are all in a 100 per cent. condition. How this is done is fully explained in an article in this issue wherein it will be discovered that the secret of success is more a matter of methods and organization than it is of equipment. As a matter of fact, no new equipment of any kind has been required at the terminals for use especially on the Mallets. At one end of the division there is not even a roundhouse which will admit one of these locomotives and allow the doors to be closed. There seem to be two or possibly three features in the methods employed at Corning and Jersey Shore that are chiefly responsible for the results. First, the locomotives are inspected minutely, making sure that every possible defect is discovered. Second, the system of checking the work insures all adjustments and repairs being properly and promptly made. Third, a traveling engineer is assigned to these 26 locomotives operating on a division about 100 miles in length. While these three features go a long way towards assuring proper maintenance, they would not be altogether successful except in cases where the locomotives were properly designed for the work they are to do. In this case 25 of the engines were built after a most thorough and exhaustive test and trial of a single experimental

locomotive. All the unsatisfactory features of design or construction were discovered on this locomotive instead of showing up on each one of a large order, as is quite frequently the case.

Engine House Reports and Records

The second of a series of articles on engine house organization and operation, by Ernest Cordeal, appears elsewhere in this issue, and suggests certain forms and records which should be used in order to secure the best results in improved engine house efficiency. To be effective such forms should be simple and as few in number as possible. Any forms which are at all complicated, either in their arrangement or in the method of handling them, will surely give trouble and cannot be expected to give satisfactory results. Then, too, duplication of work in checking up and filing the records and of making out the reports should be avoided. Charles Maier, engine house foreman of the West Jersey & Seashore, directed attention to this phase of the problem in an article on Systemized Clerical Work in the Engine House, in the Shop Section of the *Railway Age Gazette* of October 6, 1911. In studying over Mr. Cordeal's suggestions it might be well, also, to refer to the simple and effective methods which were devised by H. B. Brown, master mechanic of the Illinois Central at Memphis, Tenn. These were described in the article on Efficient Engine House Methods, by J. S. Sheafe in the Shop Section of the *Railway Age Gazette* of November 3, 1911. Mr. Cordeal's next article will deal with engine house facilities.

Criticisms of Shop Practice

In each issue of this journal there are a number of articles on shop practice. It will be readily understood that it is impossible for the editors to be conversant with every detail of the latest practice in the various shops throughout the country, and that they are to a considerable extent dependent on the readers for information on these features. We are anxious, of course, to publish the most improved methods, and are constantly endeavoring to obtain contributions or suggestions. The articles that are published are believed to be in advance of the general practice at least, but whether they are the best methods, it is often impossible to determine unless the readers who are acquainted with more improved methods than those described will give us the benefit of their knowledge. We welcome critical discussions of any article published in this journal, and urge all the readers to draw our attention to any practice, kink or arrangement they believe to be better than those published. We are now running a series of separate articles on methods of repairing driving boxes. These are all susceptible of criticism. In fact, Mr. Le Compte has accepted our invitation and his criticism of Mr. Spidy's methods appears in this issue. Mr. Westbrook's article also has a number of features that are open to criticism and discussion. We will be glad to hear from you.

General Foremen's Association

The International Railway General Foremen's Association, which is to hold its annual meeting at Chicago the latter part of this month, has been gaining steadily in strength and influence during the past two years. It occupies an important field and there is no reason why, if its members take a proper interest and back up the efforts of the officers—and it appears that they intend to do so—it should not be of equal importance with the Traveling Engineers' Association. The Master Mechanics' Association would do well to co-operate closely with these two organizations—one representing the operation of the locomotive and the other its care and maintenance in the shops and engine houses. The Master Mechanics' Association can only find time to investigate the larger and more general problems of the mechanical department, but it should be in intimate touch with the special, and none the less important, questions which confront the traveling engineers and the shop and engine house foremen. By a closer co-operation between the three organizations the work of each could be planned to supplement that of the others. There is no question but that the Traveling Engineers' Association is worthy of this confidence; it is one of the strongest and best conducted mechanical department organizations. The General Foremen's Association is younger and has had a hard time in finding its feet and getting a broad view of its work and its possibilities. Last year it made a distinct step forward and if it lives up to the standard which was set for it by those who planned the work for the coming convention it will follow closely on the heels of the Traveling Engineers' Association. Mr. Bentley, the past president of the Master Mechanics' Association, referred to the desirability of a closer co-operation with the General Foremen's Association in his presidential address and it is understood that the matter has been referred to the executive committee of that association for action.

Repairing Boiler Tubes

Mr. Pomeroy presents in an article in this issue, an arrangement for repairing boiler tubes which he is willing to guarantee will give a cost of not over 3 cents per tube from engine to engine, in shops where at least 400 tubes per day are repaired. The cost in some cases will probably be somewhat less. He accomplishes this result by selecting machines of high capacity, and so locates them that the work is continuous and without useless movement on the part of the workmen. In no case is it necessary for the tube to be reversed, nor does any man have to take more than a step or two from his position in order to obtain a tube or to deliver it to the next man. It will be noted that no allowance is made for testing the tubes after they are safe ended, and the author claims that this procedure has been found to be practically needless where a modern roller type of welder is employed. The poor welds are so infrequent that it is claimed, it will pay better to remove the occasional bad tube than to test all the tubes. There may be some difference of opinion on this point, but there is no doubt but what the modern welder is a very decided improvement and gives very much better results than most of those now in use. It is quite possible that the quality of the tube and of the safe end may have considerable effect on a decision of whether it is worth while testing or not.

It will be noted that Mr. Pomeroy has very ingenuously arranged his tube department so that the regular shop crane can be used, but at the same time the work in this department is not dependent on it, and any delay in the crane service will not effect the work in the tube department. The type of car developed on the Canadian Pacific for carrying tubes has been selected by the author, because of its very evident advantage in permitting the cars to be tiered one on top of the other, for storage. This scheme not only saves shop floor space, but makes it more convenient for handling the tubes. Superheater flues are generally about 5½ in. in diameter for the greater portion of their length, and are narrowed down to about 4½ in. at one end. It is possible to safe end the smaller or firebox end of these flues once or twice, but a point is soon reached when the neck comes too close to the superheater element, and it will be necessary to extend the larger end of the flue. For this work, Mr. Pomeroy has selected a welder capable of adjustment and use on any diameter up to 6 in., permitting the safe end to be applied to either end of the superheater flue. Since there are a comparatively small number of these large flues, he has arranged a separate group of tools for this work, which it is expected will be intermittently used. On roads where there are few superheater engines, and even these few extra machines do not seem to be ad-

visable this work can be done on the regular welder if a type is specified that is capable of sufficient adjustment.

There is no doubt but what the safe ending of boiler tubes is costing altogether too much in many shops, and that the cost can be brought within a reasonable figure by a simple rearrangement of the machines to make the work more convenient. In others, it may require the installation of one or two new tools of higher capacity. Very frequently a new cleaner will greatly increase the output and proportionally decrease the cost. Mr. Pomeroy has pointed out what he considers is the best way, and if any one can improve upon it, we will be very glad to describe his methods.

Defective Freight Cars

The report of the Committee on Overhead Inspection of Box Cars, which was presented at the recent meeting of the Master Car Builders' Association, clearly indicates, from the reception which it received, that railway officers generally are awakening to the necessity of improving the condition of the freight equipment. The committee felt that there were two ways by which the problem could be approached—to concentrate the responsibility for losses, due to defective car bodies, in such a manner as to provide an automatic incentive for the use of better cars, and to establish standard requirements for the inspection of car bodies. These are good suggestions, but the trouble is so deep seated that more radical measures will undoubtedly be necessary if a permanent improvement is to be made. In the first place the design and construction of a large portion of the box cars now in service is such that radical changes must be made before it will be possible to maintain and keep the equipment in good condition, as far as protecting the lading from the elements and pilfering is concerned. That this condition exists cannot be entirely charged against the mechanical department, for in most cases the officers of that department were strictly limited as to the amount of money that could be expended for new equipment, and were not allowed to use such designs or specialties as they believed would give the best results.

Even if the design and structure of the car is above criticism it must be watched closely to keep it in good condition. This cannot be done if the car department forces are cut down and disorganized with every fluctuation in business. The work must be done systematically and thoroughly. While at first thought this may appear to be the most expensive method, it is really the cheapest. In commenting upon this phase of the question at the recent meeting of the Master Car Builders' Association, M. K. Barnum said: "I have spent a great deal of time in the last ten or twelve years figuring on who was making their car repairs the cheapest, but have seldom been asked who was keeping their cars in the best condition. The road in the West that is the very lowest in the cost of its car repairs is also above all others in the way its cars are maintained. A great deal of the trouble starts with the buying of new cars. The question of side doors has been raised here. We all know the difference between a first class door and one that is not first class is only a matter of a dollar or two a car, but it means $2,000 for 2,000 cars, and so the cheap, flimsy door is generally specified."

Canadian Pacific Mallet

Grouping the four cylinders of a Mallet locomotive at the center of the wheel base permits a decided simplification of the steam pipe arrangement with a considerable reduction in the number of ball and sliding connections. This is well demonstrated by the simple Mallet, designed and built by the Canadian Pacific, which is described by Mr. Evans in this issue. This locomotive bears the distinction of being the first simple articulated locomotive to be put in service in this country and has been designed for comparatively high speeds. The four cylinder simple type was selected instead of the compound arrangement, because of the losses in comparative steam economy given by a compound when operated at high speeds. In addition to the simple cylinders, this locomotive presents a number of other new and interesting features. The adoption of a long drawbar with a radial buffer followed the experience with the customary pin connection on a similar locomotive built about two years ago. It takes but a moment's thought to recognize the advantage of this construction when there is as great a distance between the drivers of the two groups as there is in this case. Arranging the pins with a wedge face will permit taking up any wear that may occur on the buffers. This should be slight, as the buffers have large surfaces and are in full contact at all times. This design of buffer and drawbar connection would seem to be suitable for application between the engine and tender of any locomotive, particularly one having a very long overhang.

The design of spring supported quadrant boiler bearing and centering device is practically a duplicate of the one applied on the first locomotive, and its unaltered form is evidence of satisfactory service. This arrangement is particularly flexible and permits practically any desired resistance to the movement of the front group of wheels at any point in its travel, by a change in the angle of the bearing plate or wedge on which the quadrant operates, and also by altering the amount of weight carried on the friction-bearing plates. In the arrangement shown, at the beginning of the movement, there is a horizontal resistance of about 2,300 lbs from the rolling resistance, and about 2,500 lbs. from the friction surfaces. In the first 3¼ in. deviation from the mid position, the rolling resistance increases rapidly up to about 3,700 lbs., while the frictional resistance decreases to 1,800 lbs., the combination of the two increasing from 4,800 lbs. to 5,500 lbs. At this point the inclination of the wedge changes from one in six to one in fourteen. This reduces the rolling resistance and the combined resistance for the horizontal movement is then practically constant at 3,500 lbs. If any tendency of the front truck to nose or sway occurs, it is easy to see that a greater inclination to the first section of the wedge will tend to overcome it, and a short trial will permit the selection of the proper arrangement to give the best results.

Eight equal exhausts coming in two groups of four each that may have any relation to each other from being simultaneous to being exactly spaced, offers a problem of exhaust pipe design and front end arrangement that is new. The experiments made in arriving at a solution of this question are briefly explained by Mr. Evans. It will be seen that a design of variable exhaust nozzle gave satisfactory results, but was finally discarded in favor of an ordinary single nozzle.

This same problem was also presented on the very large simple Mallet that was put in service on the Pennsylvania last spring. Various shapes and types of nozzles were tried, and finally the most satisfactory arrangement was a nozzle with a single tip of peculiar shape, being somewhat longer from front to back than across the center. It thus appears that the double nozzle did not give satisfactory results in either case.

It is interesting to note that the feed water heater used on the first engine has been discarded and that the boiler is practically of the standard arrangement. The same tendency is quite evident throughout the country, and it would appear that feed water heaters forming the front section of the boiler barrel have not proved the success anticipated. This appears to be due very largely to the difficulty caused by the pitting of the tubes in the heater. Among the other interesting features of this design, the type of power reverse gear developed on this road should not be overlooked. This offers all of the advantages of the screw reverse gear, and is operated by steam or air.

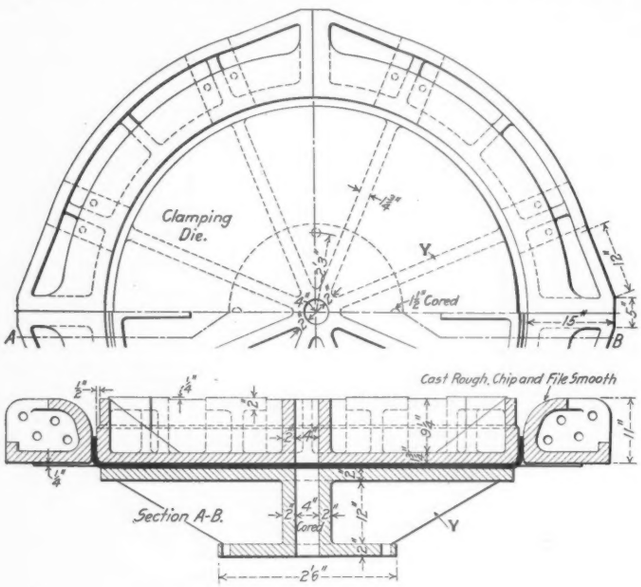
COMMUNICATIONS

FORMERS FOR HYDRAULIC PRESS

Baltimore, Md., May 3, 1912.

To the Editor of the American Engineer:

Referring to the article on the Design of Formers for Hydraulic Press on page 226 of the May issue of the *American Engineer*, I would like to call your attention to a slight error in the clamping die shown in Fig. 4, page 228. The section *AB* does not show



Formers for Pressing Boiler Tube Sheets.

the ribs that are indicated in the plan view by the dotted lines. They should be as shown herewith. The line *Y* in the elevation representing the corresponding rib *Y* in the plan view. The ribs are 1¾ in. thick and run from the extreme diameter of the clamping die to the base, making a substantial support.

LEWIS D. FREEMAN.

REPAIRING LOCOMOTIVE DRIVING BOXES

Baltimore, Md., June 22, 1912.

To the Editor of the American Engineer:

In response to your invitation for criticisms of the methods of repairing driving boxes as given by E. T. Spidy in the June issue of the *American Engineer*, I wish to submit the following:

While the time required in handling the driving boxes is remarkable in some operations, yet the inaccuracies that result from the methods employed must, in several cases, be of such a character that the erecting shop will be required to spend much time and labor to make the locomotive tram, to say nothing of the end-play of the boxes that must vary from 1-32 in. to 3-16 in. due to the uneven wear on the flanges in the shoe and wedge space. All driving boxes should caliper the same on both flanges when tested for end-play. This condition would be impossible if the methods reported are employed. If the driving boxes are set in an absolutely level position when the hot metal is applied for end-play, the running of the metal to form the liner is not regular, nor can it be made absolutely so, even if the box is heated. Therefore, all other conditions being favorable to this operation, a true surface cannot be obtained without facing the box. Very few boxes wear the same on both flanges of the shoe and wedge space. The wear on the flanges is largely caused by rounding curves and the greater wear is caused while engines are going ahead. This readily explains why some flanges are thicker than others, especially so where they are planed for vibration or oscillation. Therefore this condition would only add to the inaccuracy of the method given for pouring liners.

The seat of the saddle in the top of the boxes should also be square with the end face. This will avoid chafing of the frames and give a true bearing for the springs. The operation of slotting the crown brasses for box size is an ancient operation, as is shown by the time required to perform it. Allowing all the time specified in the time study, starting with the gaging and marking the corners and including removing from the machine, 35 minutes is required for performing this operation. It can be performed in 25 minutes on a lathe with the largest size brass measuring 13 in. by 13 in., and I have even seen these bearings turned in much less time on a vertical boring mill.

From the sketch of the gage I am unable to understand how the corners of the brass, after being slotted, will accurately fit the driving box and have an even bearing along the edges. This gage has fingers that can be adjusted in or out and apparently at a radius from the bolt used in clamping them, but it is lacking the necessary range to meet the many varied angles of these corners, as the different builders as well as different machine operators do not use the same degree or angle at this point. A slot in the fingers of the gage as shown can be used to suit the different diameters of the box, but the base on which the fingers rest should be sufficiently wide to permit a slot long enough to adjust the side fingers at any desired angle. They should be clamped together, when properly set, with a bolt, using wing nuts, thereby doing away with the wrench which is necessary to tighten up the gage as securely as will be required.

The drilling of dowel and oil holes can be best performed on a horizontal boring mill. A chuck mounted on a plate having ball bearings can be made at a small cost and will save the clamping and unclamping necessary on a drill press. The time required in turning the box over to ream from the inside is saved, as the chuck can be made to stop at any angle and ream exactly true from the inside after the holes are drilled. By utilizing such a chuck the drilling will be much handier and time will be saved.

As I have before stated, the flanges should caliper the same from the hub face, and as the wear is not the same on both flanges on the inside, all driving boxes should be faced while mounted on double knees, having a flange to clamp to the table of the boring mill and another at right angles trued off at the same height to extend beneath the flange of the box.* This should be high enough so that when boxes are placed on it, the flanges will rest on the right angle section of the knee and not on the back of the box. The box can be held firmly in place by set screws extending through the knee. This method will give an accurate surface from which to work. The driving box should then be planed in the shoe and wedge space with the face toward the knee mounted squarely upon planer. This will make the shoe and wedge space square with the face. The box should also be bored with the face against parallel strips. If the above method is carried out carefully the box will be bored absolutely central and by proving it will be found that on both the face as well as the back of the box, the exact center of the shoe and wedge space will be the center of the bearing. I thoroughly believe that the above method is the only accurate one and I know from experience that the method given by Mr. Spidy is very inaccurate. By moving the box back ¼ in. from the boring bar on the mill after boring the crown and extending the tool a little, a light cut may be taken, extending 1 in. back from the edge of the brass, which will only require a few minutes and will save the erecting shop about 20 minutes in chipping clearance.

JOHN V. LE COMPTE.
Foreman, Mt. Clare Shops, Baltimore & Ohio.

*See *American Engineer*, March, 1912, page 127.

MAINTAINING MALLET LOCOMOTIVES

New York Central & Hudson River Practice. Careful Inspection Followed by Immediate Attention to All Adjustments and Repairs Is of Vital Importance.

Twenty-six locomotives of the 2-6-6-2 type are in regular road service on the Pennsylvania division of the New York Central & Hudson River between Corning, N. Y., and Jersey Shore, Pa. This division includes some fairly difficult grades, as is shown in Fig. 1, and has numerous curves. The freight trains are operated at an average speed of 15 miles an hour, and up to about one year ago it required 60 large consolidation locomotives, with a tractive effort of 45,700 lbs. each, to move 1,000 loaded cars over the division in 24 hours; 29 of these were used as pushers on the heavier grades. When it became evident some time ago that the increasing traffic would soon necessitate either double tracking or the operation of heavier trains at the same speed, consideration was given to the possibility of using an articulated type of locomotive.

One engine of the 2-6-6-2 type was purchased and careful tests were made with it in comparison with two different designs of consolidation locomotives.* These tests extended over a period of two and a half months, and resulted in the purchase of 25 more Mallet locomotives of the same design as the one tested. These locomotives are of the 2-6-6-2 type, and were built by the American Locomotive Company. They are fitted with Schmidt superheaters which have 966.3 sq. ft. of heating surface. The cylinders are 21½ in. and 34 in. x 32 in.; the steam pressure is 200 lbs., and the drivers are 57 in. in diameter. The locomotive has a total weight of 354,000 lbs., of which 301,500 lbs. are on drivers. The tractive effort is 67,500 lbs. working compound and 81,000 lbs. working simple. The rigid wheel base is 10 ft.; the total driving wheel base is 30 ft. 8½ in., and the total wheel base of the engine and tender is 75 ft. 8 in. There are 235 2¼ in. and 36 5½ in. tubes 22 ft. in length, which give a heating surface of 2,468 sq. ft. The total heating surface of the boiler is 3,293 sq. ft., and grate area is 56.5 sq. ft. All the locomotives are fitted with Security brick arches. The boiler is of the straight top type, having a radial stay firebox, and measures 83¾ in. diameter at the front end. The high pressure cylinders have piston valves, while the low pressure cylinders are fitted with slide valves. The Mellin system of compounding is employed, having an intercepting and a pressure reducing valve in the high pressure cylinder saddle, with a separate exhaust when the locomotives are operating simple.

On the test, the Mallet locomotive handled 3,461 tons behind the tender at 15 miles per hour and 3,734 tons at 12½ miles per hour. After one year's continuous service all of the locomotives are handling an equal tonnage at speeds as good as or better than those obtained in the test. They are doing this easily and to the complete satisfaction of all concerned. The fuel and water consumption is practically the same as was obtained on the tests which required .084 lbs. of coal per ton-mile at 15 miles per hour. This was practically 40 per cent. less than was required by either of the consolidation locomotives at the same speed.

This continued excellent service of all of these locomotives indicates that they were properly designed for the conditions, that they were well built, and, most of all, that they are being properly taken care of at the terminals. Even with the first two conditions beyond criticism, without proper attention to maintenance the present satisfactory results would not be obtained.

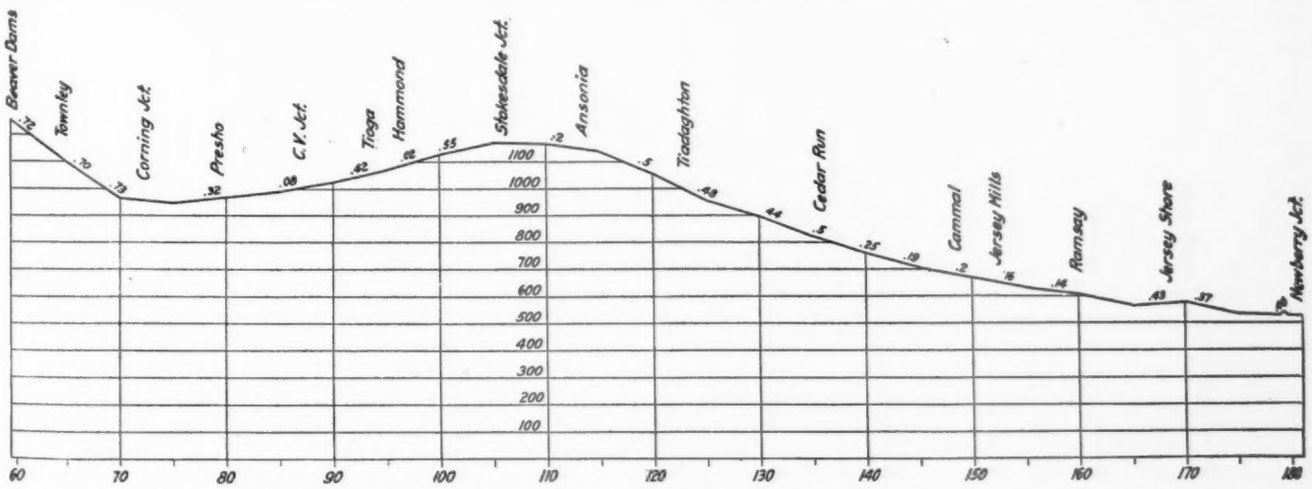


Fig. 1—Profile of Pennsylvania Division of the New York Central & Hudson River Between Jersey Shore and Corning.

The secret of the success in the maintenance of these locomotives, as well as all the others running into the same terminal, lies in the extreme care taken in inspection and the immediate attention given to all adjustments and repairs. No locomotive is allowed to leave the terminal at either end with any work left undone which has been reported by the engineer or the inspectors, if it will, even in the slightest degree, effect the operation of the engine. The result is that after a year's service every one of the locomotives is practically as good as new, and is performing work every day equal to that done by the original engine under the special conditions surrounding the test runs.

A new locomotive terminal* was placed in operation during the year 1910 at Corning, N. Y. This included a new engine house of the standard New York Central design, having normally 92 ft. interior space between walls and including five pits in a drop pit section which is 115 ft. between walls. In these long pits the Mallet locomotives can be easily housed, but

*For full report of the tests and description of the Mallet locomotive, see *American Engineer & Railroad Journal*, December, 1911, page 471.

*For fully illustrated description, see *American Engineer & Railroad Journal*, December, 1911, page 461.

in the shorter ones it is only by practically blocking the passage at both ends that they can be taken inside the doors. There is an excellent machine shop with a tool equipment sufficient for running or light general repairs. At Avis (Jersey Shore), however, the engine house has but few of the 92 ft. pits, and it is practically impossible to completely house the locomotives at this point. New construction will soon be undertaken here which will give an ample number of pits of sufficient length to easily accommodate the Mallets. The Avis repair shops are located near the engine house, and provide ample facilities for coal chute by its regular crew. It is then taken in charge by the hostler who fills the tender with coal and water, and the sand box with sand, and sees that the fire and the water level are in proper condition before leaving it. The engineer on his way to the engine house stops at the office of the inspectors and dictates to the clerk in charge a memorandum of any repairs or adjustments that he considers necessary. This work is entered by the clerk on forms M.P. 344 and 345 (Figs. 2 and 3) which are bound in book form. Each separate subject is given a separate item and after being entered, they are read

Form M. P. 344 N. R. 5824

NEW YORK CENTRAL LINES

Condition of Locomotives at end of trip, and of Air Brake Equipment before leaving terminal.

Date_____ 19____

Loco. No.	SAFETY VALVE		AIR PRESSURE		* CONDITION OF				SIGNATURE OF ENGINEMAN	AIR BRAKE EQUIPMENT INSPECTED BY ME AND FOUND IN GOOD CONDITION BEFORE LOCO. LEFT THIS TERMINAL (To be signed by A. B. Insp.)
	Lifts at Lbs.	Seats at Lbs.	Reservoir Lbs.	Train Line Lbs.	INJECTORS Right	INJECTORS Left	Gauge Cocks	Glass Water Gauge		
* IF CONDITION IS NOT O K. THE DEFECTS MUST BE SPECIFIED IN BOOK, FORM M. P. 345										

Fig. 2—Form for Reporting Condition of Safety Valves, Air Brakes, Injectors, Gages, etc.

all classes of repairs. An 85 ft. electrically operated turntable at both points is of sufficient size to easily turn these locomotives. There is no special equipment of any nature provided for the Mallets at either end of the division, nor are there special men assigned to work on them. They are treated in every way the same as any other locomotive that comes to the terminal.

A traveling engineer is assigned to this power and spends a large proportion of his time on the road riding the Mallet over and personally signed by the engineman, who then proceeds to the engine despatcher's office, "signs in," obtains his mail and is relieved. The fireman accompanies the engineman, and any work he has to report is included with that of the latter.

When the inspection pit is cleared, the chief inspector boards the locomotive at the coal chute and brings it to the inspection pit. Four men then proceed to examine it. One inspector in the pit examines all of the running gear that is visible, or can

Form M. P. 345 N. R. 5825

NEW YORK CENTRAL LINES

Condition of Locomotives at end of Trip.

Date_____ 19____

Loco. No.	The Locomotive is in good condition, with following exceptions (To be signed by ENGINEMAN & INSPECTOR)	Disposition of each item of work Reported 1. Repaired 2. Work not Necessary 3. Held over	No. of forms M. P. 347 Issued for each Loco.

Fig. 3—Form for Reporting Condition of Engine at End of Trip.

locomotives. This practice undoubtedly has a decided bearing on their successful operation. One traveling engineer to 26 locomotives on a division about 100 miles in length is undoubtedly an efficient arrangement and will have considerable effect on train operation. A traveling fireman is assigned to all of the locomotives on the division, and the Mallets obtain simply their proportion of his attention. All of the locomotives have regularly assigned enginemen and firemen.

On coming in from a trip, the locomotive is brought to the be reached from that point; another on the ground outside examines all parts of the running gear, frames, cylinders, boiler and its attachments that are accessible from this point. He carefully notes the condition of the brick arch, flues, grates, etc. A third inspector carefully examines all parts of the air brake system. The fourth inspector is a helper who fills all grease cups and headlights, applies new bell cords, puts soda ash in the tank, etc. These inspectors are provided with wrenches and hand tools, and take care of all repairs which

can be made without delay, such as tightening loose nuts, applying cotter keys, putting on new brake shoes, packing tender journal boxes, draining air reservoirs, taking up the slack of brake cylinder push rods, etc. This work requires from 30 to 45 minutes for a Mallet locomotive under ordinary conditions, and not infrequently as much as 50 minutes or an hour are used. Upon its completion, each inspector reports to the desk, examines the engineer's report, and dictates to the clerk any other work he has found necessary. This is entered below the engineer's report and is signed by the inspector.

A hostler then takes the locomotive from the inspection pit to the cinder pit, where the fire is cleaned, the outside of the boiler and the running gear washed down with a hose; the engine is then taken to the house. At Corning, the fires on all Mallet locomotives are dumped, while at Avis they are usually only cleaned. This is done because of the rule in force that requires all boiler tubes to be blown with air, and the brick arch to be cleaned off at the end of each round trip.

Items on forms M.P. 344 and 345 are transferred by the clerk to form M.P. 347 (Figs. 4 and 5). A separate slip is made out for each item, and these are numbered consecutively for each locomotive and the number is entered in the last column of M.P. 345. These slips are sent to the engine house and placed on the foreman's desk. As soon as the locomotive comes in its number is entered on the blackboard near the foreman's desk opposite the proper pit number. The work slips are then placed in pigeon holes corresponding to the pit number on which the locomotive is standing. Those for the attention of the boiler maker, air brake gang, cab work, etc., are placed in separate pigeon holes under these headings.

From here the engine house foreman distributes the work to the machinists, giving each a slip corresponding to the job that he is to perform. After the repair or adjustment is made, the slip is signed by the workman and returned to the foreman's desk. If, for any reason, such as lack of material, lack of time or the necessity for a decision from higher authority, it is impossible for the workman to perform a comparatively unimportant piece of work, he fills in the space on the back of the card, giving the proper reason in full. This is approved

(O. M. P. Co. 38101). Form M. P. 347.

NEW YORK CENTRAL LINES

LOCOMOTIVE WORK CARD. No._____

Eng. No.	Eng'r.____or Insp.____	Place and Date _____
Above Work Performed by		Date

Fig. 4—Face of Locomotive Work Report.

by the foremen and placed in a separate pigeon hole for all unfinished work. The cards for completed work are returned to the inspector's office each day, where they are checked off against the items on M.P. 344 and 345, and filed under the engine number in a special cabinet.

There has been nothing of any importance that can be noted as giving special trouble on the Mallet locomotives. The ball joints on the receiver pipe require slight adjustment about once a month and a renewal of packing on an average of about once in three months. Some difficulty was found with the sand pipe leading to the front group of wheels, as it was originally applied. This, however, has been overcome by the substitution of metallic hose for the slip joint arrangement previously used. The intercepting valve chamber requires opening on an average of once in every three or four months for the purpose of cleaning and lubricating. It was found that this valve had a tendency to stick, somewhat like an air brake triple valve, at about these intervals. It is easily accessible, and this work is easily and quickly performed. No trouble has been given by the cutting of the packing either on the valve stem or the piston rod by the superheated steam since the application of the style of packing now in use. It is seldom that a report is made of valve or piston packing blowing. Although no flange lubri-

REMARKS—Why Not Done	Foreman	Date

Fig. 5—Back of Locomotive Work Report.

cators are used on the drivers, they show no sharp flanges after over 30,000 miles service. Indications are that the tires will give a mileage close to 50,000 before they require turning. Grease driving box lubrication is employed and hot boxes are very infrequent. No trouble at all is given by leaky flues, although the water is not specially good. Before the application of the brick arch on this division, leaky flues were frequent and troublesome, and it is believed that the arch is largely responsible for their great infrequency at the present time. The arch is run down solid against the throat sheet.

One of the Mallet locomotives is fitted with a Street stoker; it has been in regular service for a year, and is operating with great reliability. It has been found necessary to increase the size and weight of some of the parts, but no engine failures have been assigned to the failure of the stoker.

There are a number of two cylinder Richmond compounds in use out of the Avis terminal, which gives the workmen at this point a familiarity with the Mellin system of compounding that is of some advantage in the maintenance of this feature of the Mallets.

LINEN IN DINING CARS.—Some figures showing the amount of work involved in caring for the linen used on the dining cars of a large railway system have been compiled by the Southern Pacific. An average of 315,000 pieces of linen are laundered each month in this department, including 100,000 napkins, 100,000 dish towels, and 40,000 table cloths, and each piece is carefully looked over by inspectors to detect tears or signs of wear. At the commissary department at Oakland, Cal., there is maintained a linen repair room where thousands of napkins, table cloths, dish towels and cooks' and waiters' aprons are kept in perfect condition. Fourteen electrically-operated sewing machines are kept running steadily eight hours a day and six days a week. With these machines it is said that a hole in a piece of table linen can be darned so well that it is sometimes impossible to detect the stitches from the original weave. Each piece of linen as it is brought in from a trip is counted and careful count and inspection are continued until it is returned. In employing women for this work preference is given to dependent relatives of employees who have been injured or killed

SHOP KINKS

The following shop kinks or devices are in use at the Tyrone, Pa., shops of the Pennsylvania Railroad.

TIRE TRUCK.

The truck shown in Fig. 1 is used for carrying tires to and from the storage yard. It is made of ¾ in. x 1¾ in. bar iron. The wheels are 13½ in. in diameter and are spaced far enough apart to give sufficient stability and to allow the tires to set securely on the 4½ in. steps shown on the side view of the truck.

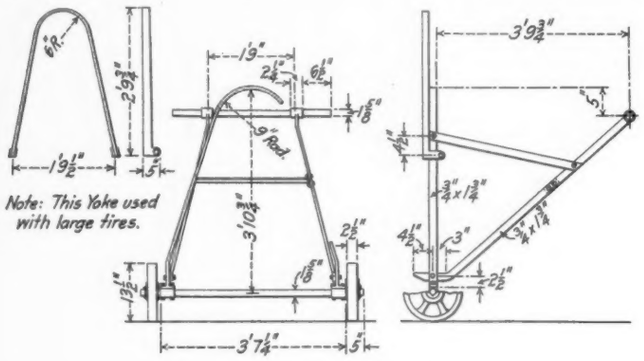


Fig. 1—Truck for Carrying Tires.

The truck was first built for handling small tires and proved so successful that a yoke was added, as shown, to accommodate the larger ones. When the handle is pressed downward the tire slopes back enough so that it will not be jarred off.

SAND DRYER.

The steam coil shown in Fig. 2 has been in continuous service for three years, drying about 12 tons of sand per day. It is made up of 24 sections of 1¼ in. pipe. The bottom section contains four slides or covers, which are removed when it is desired to clean the coil. It is located below the sand bin, and two chutes, 2 ft. in diameter, conduct the green sand from the bin to the coil. The pipes have not rusted since they were installed three years ago and seem to be in good condition.

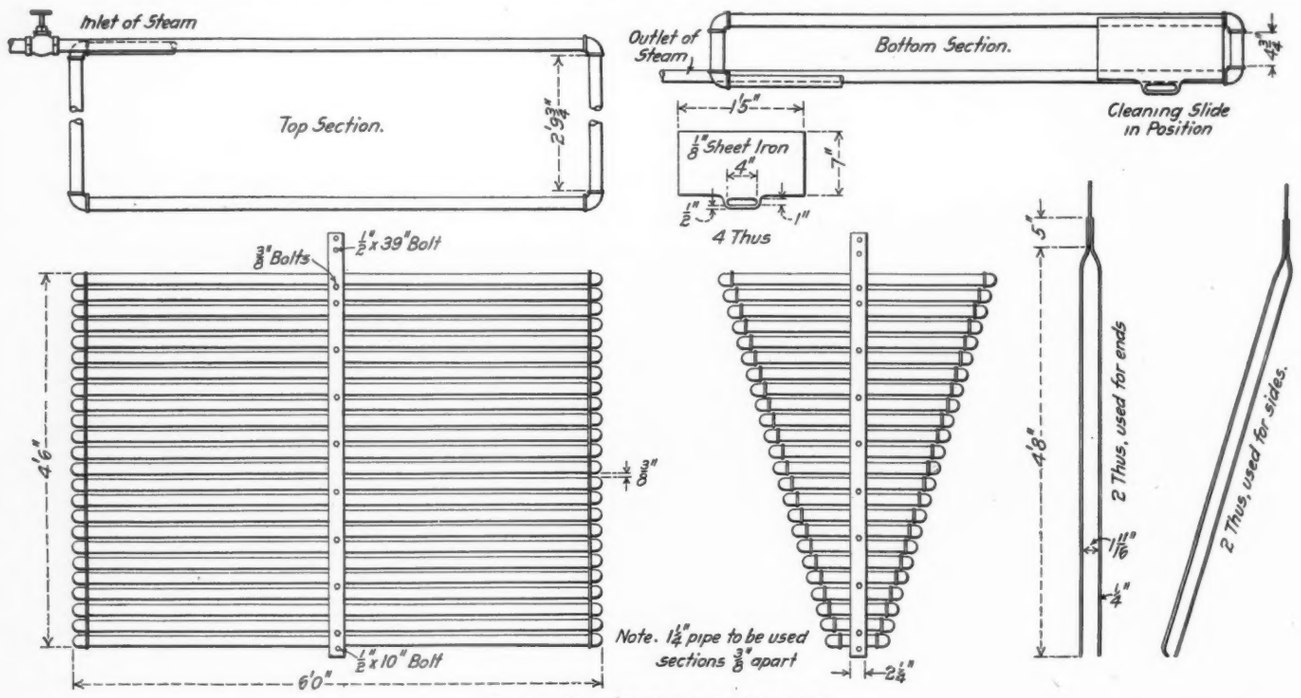


Fig. 2—Steam Coil for Drying Sand.

IRON BOX FOR DIRTY WASTE.

The box shown in Fig. 3 is used as a receptacle for dirty waste. Its chief point of merit is that the cover is always closed, except when the waste is either being put in or removed from the box. The cover is swung on the pin *A*, and is opened by pressing on the treadle *B*, which is connected to the cover by the ⅜ in. x 1 in. bar *C*. The dot and dash lines show the position of the cover, bar and treadle when the cover is raised. The weight of the cover is sufficient to close it down when the foot is removed from the treadle *B*. As will be seen, the bar is enclosed in a pocket which allows it to operate easily.

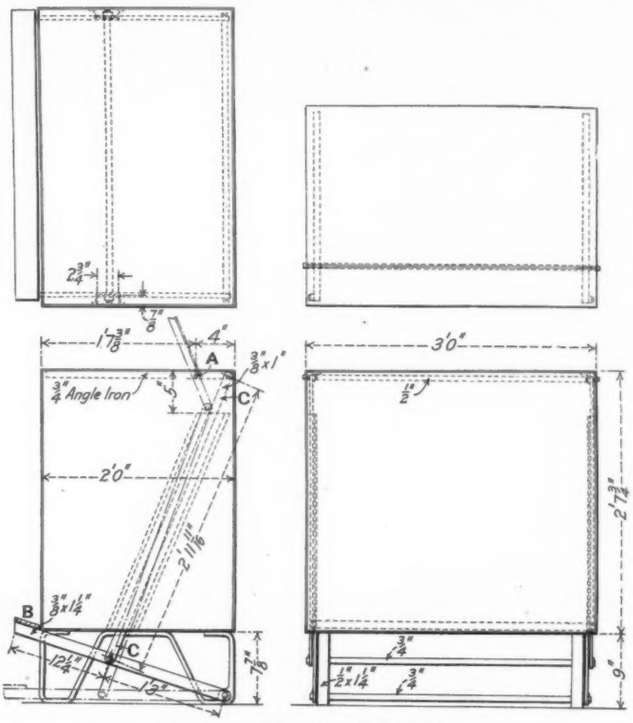


Fig. 3—Iron Box for Soiled Waste.

ENGINE HOUSE REPORTS AND RECORDS

Must Be Few in Number, Brief, Accurate and Comprehensive and Must Be Designed for Use in Permanent Files Which Can Easily Be Referred to.

BY ERNEST CORDEAL,
Atchison, Topeka & Santa Fe, La Junta, Colo.

Next in importance to effective organization in promoting efficiency in the engine houses comes accurate, concise and immediate reports and records to indicate the work which is to be, or has been done. After a satisfactory organization has been perfected the next step is to provide its members with a simple, yet complete means of conveying the necessary information and instructions to govern the movement of the men and to insure the furnishing of such data as will be necessary to maintain the requisite records.

The suggestion of such forms, few in number and entailing the minimum of clerical labor, as are necessary to cover the various operations at engine houses is the purpose of this article. These forms, eight in number, may be designated by the following heads: Engineers' work report; inspectors' work report; hostlers' report of engines handled; foremen's report of work done; daily line-up; daily report of engines handled; monthly report of engines handled; monthly inspection report. These few reports, it is believed, will fill the general need, furnishing all the information that is necessary without duplication.

ENGINEERS' WORK REPORT

Engine Number_____

Station_____ Date_____

MACHINERY

Part.	Side.	Work Necessary.

BOILER.

Part.	Side.	Work Necessary

_____ Engineer.

Fig. 1—Engineers' Work Report.

Engineers' Work Report.—We hear constant complaint from engine house foremen to the effect that engineers do not properly report work. As constantly, the engineers contend that work which they report is not done. Both contentions are no doubt true to a great extent, and there is little doubt that the responsibility for this condition lies in the fact that the forms used for the reporting of work, in the majority of cases, are neither adequate nor convenient. Probably the most prevalent method of handling engineers' work reports is to have, in the office of the engine house foreman, a book in which the engineer is expected, after the completion of his trip, to enter the items of work which he considers it necessary for the repair force to do before the engine is again called into service. Too often an examination of work report books of this nature reveals the fact that their pages contain essays by individual engineers on the subject of the general run-down condition of the particular engine they happen to be running, but are peculiarly devoid of any definite information as to what parts should be repaired or renewed. Other reports consist of minutely detailed accounts of the work which, in the engineer's opinion, should be done and in some cases also contain definite instructions as to how the work should be performed.

A work report of this kind must be read over by the foreman, or more generally by his clerk, who culls out such points as he considers necessary for the preparation of work slips to be distributed to the workmen. In so doing it is more than likely that the elaborately written report, giving details as to the performance of the engine and specific instructions as to the method of making repairs, will receive but slight consideration, only a few of the most important points being transmitted to the men performing the actual work. In this way really important matters, which are to an extent covered up by the verbosity of the reportee, may be entirely overlooked, giving the engineer cause for his complaint with regard to work reported and not done.

The form suggested as an engineer's work report is illustrated in Fig. 1. This form should be made up on sheets of convenient size to be carried in the pocket; say, 4 in. x 7 in., and bound into books with pliable covers, each sheet being perforated so as to be easily removed as used. The idea is that the engineer should carry one of these books with him on the road and should enter therein the defects which develop during the actual operation of the engine. This removes the possibility of items being forgotten, which is a thing of not unusual occurrence where the report is not made until the end of the trip. Another advantage is that on the arrival at a terminal the report is complete and it is only necessary for the engineer or fireman to drop it at the foreman's office instead of spending a considerable amount of time which rightfully belongs to them in thinking over and recording the weak points on the engine.

The report is made in such form as to insure the greatest brevity consistent, furnishing as it does the name of the defective part and the location and nature of the defect, which is all the information needed by the mechanic who is to make the repairs. The work on the machinery and the boiler is separated so as to minimize the efforts of repair foreman in segregating the items under each head.

Inspectors' Work Report.—After the arrival of an engine at the inspection pit or in the engine house, it should be thoroughly looked over by a competent mechanic for the purpose of detecting any defects which may have escaped the notice of the engineer. Before making a report the inspector should carefully peruse the engineer's work report to avoid any duplicate reporting of work, after which he should fill out a form as shown in Fig. 2, which is substantially the same as that used by engineers and is merely a supplement thereto. These two work reports furnish the information necessary for the engine house foreman

to make an estimate of the length of time that will be necessary to complete the repairs and make the engine ready for service. They also furnish to the repair foremen the data which they require in assigning workmen to the various repairs. The use of these forms in expediting repairs and as a permanent record will be discussed later in relation with the other forms suggested.

Hostlers' Report of Engines Handled.—The form illustrated in Fig. 3 is for the use of the head hostler in conveying information as to engine movement to the engine house foreman, and should be handled as a daily record. As to size and binding, the recommendations for the engineer's work report might be advantageously followed in this case. As soon as an engine is turned over by the engineer to the engine house force the engine number and exact time of the transaction is recorded in columns 1 and 2. When the engine has been properly supplied, the fire knocked, and it has been placed in the engine house, the time is recorded in column 3, which indicates its passing from the hands of the hostling force to those of the repair foremen. When the

INSPECTORS' WORK REPORT

Engine Number_____

Station _____ Date _____

MACHINERY.

Part	Side.	Work Necessary.

BOILER.

Part.	Side.	Work Necessary.

_____ Inspector.

Fig. 2—Inspectors' Work Report.

engine is again under steam with repairs complete, the time is entered in column 4, this representing the time when the responsibility for the engine's movement is again shifted from the repair foremen to the hostling force. After the necessary work of fueling, sanding and watering has been performed, and the engine is turned over to the crew, column 5 is filled in, indicating the end of responsibility for the engine house force.

The sixth column is to be entered from the "line-up," and represents the time at which the engine must be turned over to the road crew to insure ample time for them to proceed from the engine house tracks to the train. The seventh and eight columns are for the purpose of recording delays to outgoing engines for which the engine house force is responsible, the former giving the duration of such delay and the latter furnishing the explanations. Under an effective organization these two final columns will, as a general rule, be superfluous, but even at the best managed engine house delays, seemingly almost unavoidable, will occur at rare intervals.

The work of each shift should furnish a complete report on this form, that is, the movement of all engines handled by the shift should be entered on one form which at the end of the working day is turned in to the engine house foreman's office.

HOSTLER'S REPORT OF ENGINES HANDLED

Station _____ Date _____

Engine Number.	Time Received.	Time in House.	Time Ready.	Time Delivered.	Time Wanted.	Delayed.	Cause.

_____ Head Hostler. _____ Shift.

Fig. 3—Hostler's Report of Engines Handled.

It will be understood, of course, that all columns will not be filled out on a single report for each of the engine numbers given, as in a large number of cases engines which are handled in on one shift will not be handled out until the following shift.

FOREMAN'S WORK REPORT

Engine Number_____

Station _____ Date _____

Time Received _____

Time Ready _____

Part.	Side.	Work Done	Man Number

WORK REPORTED AND NOT DONE.

Part.	Side.	Work Not Done.	Reason.

_____ Foreman.

Fig. 4—Foreman's Work Report.

It will be seen then that these forms, if intelligently handled, will constitute a continuous record of locomotive movements from shift to shift and from day to day.

Foreman's Work Report.—The form shown in Fig. 4 is for the

use of repair foremen in recording the actual work performed in the progress of repairs, and further to indicate the reported work which was not done and the reason for its neglect. A book of these forms, similar in size and make-up to the engineers' work report, should be constantly in the pocket of each repair foreman. Immediately on a locomotive being placed in his hands by the hostlers he should enter the engine number,

DAILY LINE-UP

Station _____ Date _____

Engine Number.	Train Number.	Time.	Repairs Complete.	Engine Ready.	Remarks.

_____ Engine House Foreman.

Fig. 5—Form for Report of Daily Line-Up.

date and time received, which should correspond with the time shown in column 3 of the hostlers' report. As the work progresses the various operations should be entered, together with the number of the mechanic assigned to the job. After the repairs have been completed the time should be entered in the proper place and the report may then be checked against the

LINE-UP CHANGE SLIP

Station _____ Date _____

Time Issued _____

Add to Change } Line-Up as Follows.

Engine Number	Train Number	Time	Repairs Complete	Engine Ready	Remarks.

_____ Engine House Foreman.

Fig. 5a—Line-Up Change Slip.

work reports to determine the operations which were not performed.

It frequently occurs that work reported by engineers or inspectors is found to be unnecessary, in which case the proper notation will be made under the caption "Reason." Other work, not of vital consequence, it may be found expedient to defer until a subsequent trip, and in this case, the repair foreman, by allowing the work to be shown in the "not done" section of his report, makes himself responsible for the ability of the part in question to make another trip over the road without danger.

Daily Line-Up.—The purpose of this form, as illustrated in Fig. 5, is to furnish to the interested parties the fullest information possible as to the engines which will be required for service during the day and the time at which they must be ready. The line-up should be made in the engine house foreman's office before the beginning of the working day, so as to be in the hands of the various foremen when work is commenced. The necessary information as to the time of delayed trains, and also as to the requirements for extra power must be obtained from the chief despatcher.

It will be well understood, by anyone conversant with engine house operations, that any such line-up as this issued to cover a 24-hour period must be subject to revisions at any time in order to take care of unexpected demands for power or unpredicted delays to regular trains; it will be found necessary to

DAILY REPORT OF ENGINES HANDLED

Station _____ Date _____

Engine Number.	Arrived.	Received.	Repairs Completed.	Ordered For.	Ready.	Departed.	Delayed.	Detention. MD.	Detention. TD.

Total Engines Out _____

Detention Mechanical Department _____

Detention Transportation Department _____

Delays _____

Fig. 6—Daily Report of Engines Handled

provide for such emergencies by the use of a line-up change slip (Fig. 5a), which should be issued immediately on receipt of information to advise all parties that a change of plans will be necessary. On some roads it is necessary for the mechanical department to furnish the transportation department with a line-up report showing what engines are available for service and at what time they will be ready. The preparation of this statement is a matter of little difficulty where reliable work reports are furnished, and a form similar to Fig. 5, but giving only engine numbers and time ready, could be advantageously used.

Daily Report of Engines Handled.—As a vehicle of information to officers and as a permanent record for the supplying of the necessary data to complete certain general reports, it is important that a daily statement should be issued covering the history of locomotives, while in charge of the engine house force. In Fig. 6 is illustrated a form which it is believed compiles the needed information in the most concise form possible.

This report shows the time of arrival of trains at the ter-

minals, as indicated by the engineers' register, the time of arrival of engine at engine house tracks, taken from the hostlers' report; the time at which repairs are completed, as indicated by repair foreman's reports; the time ordered for, which is given on the line-up; the time ready, as shown on the hostlers' report; and the time of departure from engine house track obtained from hostlers' report. The time of detention, as divided between mechanical and transportation departments, is given in the two final columns. The mechanical detention is obtained by determining the lapse of time between the "time arrived" and the "time ready," while the transportation detention is derived by deducting the mechanical detention from the total time out of service.

The column for delays has been introduced to provide a means of conveying this information to the officers interested and to insure its being given a place on monthly reports. In closing out this report for the period the total number of engines handled out should be shown; those coming in, but not leaving again during the period, being counted at their departure on succeeding days; the total time of detention by mechanical and transportation departments should be totaled separately. The total delayed time for which the engine house is responsible should also be shown.

Monthly Engine House Report.—This report, as illustrated in Fig. 7, is in intent a recapitulation of the daily reports showing for the monthly period the amount of work performed. For each day is given the number of engines supplied to trains, the number and time of delays, and the time of detention chargeable to the two departments. In case further information is desired, as for example the number of boilers washed, number of engines wiped, or other detail data, this report may easily be extended to include these items and the necessary information would be easily obtainable from the foremen's work reports. The totaling of the various columns gives comparative figures as to the number of engines handled, the distribution of detention time and the number and time of delays. The greatest value of a report of this kind lies in absolute accuracy, and the form suggested cannot fail to attain this end, provided the daily reports on which it is based have been properly handled.

MONTHLY ENGINE HOUSE REPORT

Station _____ Date _____

Date	Engines Handled.	Detention.		Delays.	
		Mech.	Trans.	Number.	Time.

_____ Foreman.

Fig. 7—Monthly Engine House Report.

Monthly Inspection Report.—Fig 8 suggests a form, which if properly handled, should prove of great value to master mechanics in keeping the condition of power well in hand, in anticipating shopping dates of the various engines and in making provision in advance for expediency in shop repairs.

It will no doubt be generally acknowledged that a thorough monthly inspection of each locomotive, both as to machinery and boiler, conducted by competent mechanics, is not only a measure of safety, but one of ultimate economy as well. Minor defects will in all probability develop at such inspections which would be entirely overlooked or ignored in the daily inspection by engineers and inspectors. Such defects by being detected in time will undoubtedly lead to their correction, eliminating the possibility of a total break down entailing expensive repairs and the inconvenience of being required to hold engines out of service. The form suggested is to serve the purpose of a brief condition report covering all engines assigned to a division and the date shown is to be obtained from the detailed inspectors' reports covering the condition of each engine.

MONTHLY INSPECTOR'S REPORT

Station _____ Date _____

Engine Number	General Condition.		Detail Condition.								Remarks.
	Machinery.	Boiler.	1	2	3	4	5	6	7	8	

Column 1—Valves and Valve Gear.
Column 2—Guides and Pistons.
Column 3—Main and Side Rods
Column 4—Carrying Gear.
Column 5—Driving Wheels, Boxes.
Column 6—Steam and Dry Pipes.
Column 7—Firebox.
Column 8—Flues.

Fig. 8—Monthly Inspector's Report.

The columns under the head of "General Condition" are intended to convey information as to the estimated time the engine is good for before it will require a general shopping. The numbered columns following cover various detail parts. Each of these columns should be filled in with a suitable symbol to indicate whether that particular part of the locomotive is in the best condition or whether light repairs should be made to avoid more serious wear or breakage. In case certain parts are marked as in need of attention the repair foremen should be instructed to overhaul the parts in question at the first opportunity, thereby evening up the conditions as between members and setting back the date at which the engine will have to be shopped. A comprehensive form covering individual engines to assist in the monthly inspection could be easily devised, but as this would of necessity vary widely with the class of power used and methods employed on various roads no definite form has been suggested.

THE USE OF THE FORMS.

The utility of reports and records depends not so much on their adaptability and the perfection of the form as upon the accuracy with which they are made up, the effective use which is made of them in assisting supervision, and the availability as a record of past performance. To serve their purpose to the fullest extent, therefore, reports should be as few, brief and comprehensive as possible. To insure accuracy they should be executed in immediate sequence with the performance of the work and not after a lapse of time when their correctness depends entirely upon the memory. To provide permanence and availability in past records, forms should be designed with a view to forming permanent files, insuring easy reference to any information which may be required at any subsequent date.

The work reports of engineers and inspectors should pass

through the hands of the engine house foremen to those of the repair foremen as their guide in performing the necessary work. In order to avoid the necessity of making these reports in duplicate to supply the necessary information to foremen in charge of machinery and boiler repairs, and also to protect the reports from loss, destruction, or partial obliteration, it will be found advisable to provide small boxes on the wall of the engine house immediately in front of each pit in which the reports may be placed which refer to the engine occupying the stall. The reports should be placed in the boxes immediately upon arrival of the engine in the house. This plan obviates the necessity of making work orders for each individual operation to be performed, as the foreman has simply to consult the report and assign workmen to the various jobs. The workmen will have easy access to the reports in case of dispute or uncertainty as to the work required.

The foreman's report of work performed should also be deposited in this box, so as to be available to both machinery and boiler foremen, who may use the same form, thereby concentrating all information for each engine on one blank. After the completion of repairs the three reports should be collected and filed in the engine house foreman's office under engine number and in date sequence. A cabinet, containing pigeon holes corresponding in number to the assigned power, will be found the best method of filing these reports. It is constantly necessary to refer back to work reports for preceding trips and the suggested forms and system of filing provide a means of accomplishing this with the minimum of effort.

The hostlers reports of engines handled must of necessity remain in the possession of the head hostler during his shift and be turned in to the foreman's office only at the end of that period, where they should be filed in date order, forming a consecutive history of engine movements through the engine house.

The daily line-up together with the line-up change slips provide the engine house foreman with a method of issuing the pertinent instructions to his subordinates as to power requirements. This form should be made in manifold, so as to provide copies for each of the repair foremen, for the head hostler, and also a file copy to be retained in the office, which after the end of the day is filed in date order as a permanent record.

The three remaining reports, "The Daily Report of Engines Handled," "Monthly Engine House Report," and "Monthly Inspection Report," are primarily for the information of the master mechanic and higher mechanical department officers. They are simply compiled from detail reports furnished by foremen and inspectors, which work is performed by the clerical force.

It is of course realized that the forms suggested may not provide a means of furnishing all of the data which may be required of the engine house, the quantity and subject of such information being a matter of local preference. Any or all of the forms may, however, without change of principle be adapted to the requirements on any division or system, where either more or less information than that provided for is required, by simply contracting or extending their scope. It is believed that the system suggested will insure the greatest accuracy coupled with effectiveness and simplicity.

RAILWAY WAGES.—The Bureau of Railway Economics, having made a study of the railway conditions in the United States and the principal countries of Europe, states that the average daily compensation of railway employees of all classes for the year 1910 was $2.23 in the United States; $1.05 in the United Kingdom; 81 cents in Prussia-Hesse, excluding the supplementary allowance negligibly affecting the average, and 89 cents in Austria. The lowest paid railway employee in the United States receives a greater compensation than those on any railway of France and more than some of the higher grade of employees with responsible duties.

SHOP KINKS

BY M. H. WESTBROOK,
Grand Trunk, Battle Creek, Mich.

MACHINING TIRE RETAINING RINGS.

The machining of retaining rings is a large item on roads that use them, and there are several different methods for doing the work; the one described herewith is the simplest and most satisfactory of any yet tried by the writer. Four holes are drilled

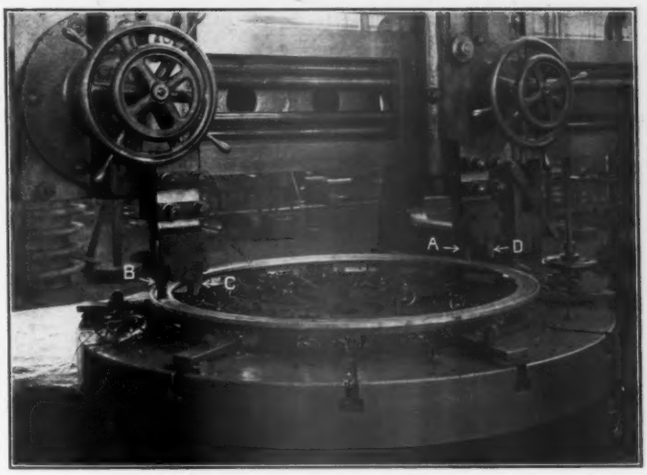
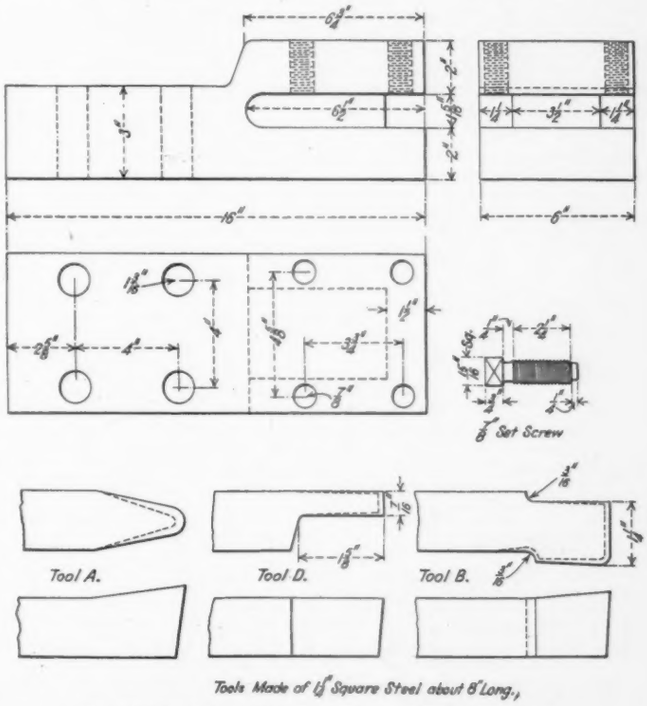


Fig. 1—Machining Tire Retaining Rings.

and tapped in each ring at points that are spotted for rivet holes. The ring is then attached to the jig shown in Fig. 1 by cap screws set in from the underside of the jig, the screws, of course, not being long enough to extend through the ring. The jig is



Tools Made of ⅝" Square Steel about 8" Long.

Fig. 2—Tools Used for Machining Retaining Rings.

then centered and clamped to the table of a two-head boring mill. The finished retaining ring is shown in Fig. 3.

There are two tools fixed in each tool holder, which are shown in detail in Fig. 2. The tool *A* is set in the right hand head, and is used to finish the face of the ring in one cut. The tools *B* and

C (Fig. 1) are set in the left-hand head to turn the outside and inside diameters respectively. These tools are spaced in the holder to give the required width of ring, and are started immediately after the tool *A* has begun to cut. The tool *B* is so shaped that it may be used to round over the under-corner of

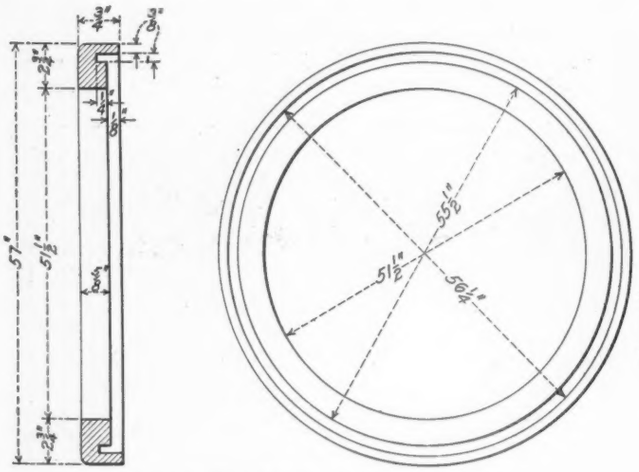


Fig. 3—Finished Tire Retaining Ring.

the ring after the diameter has been turned, in this way eliminating the necessity of setting a separate tool for that purpose. It is not necessary to turn over the corner on the inside of the ring. The tool *D* is used to form the groove in the ring after it has been faced off by the tool *A*. As the tool *A* approches the

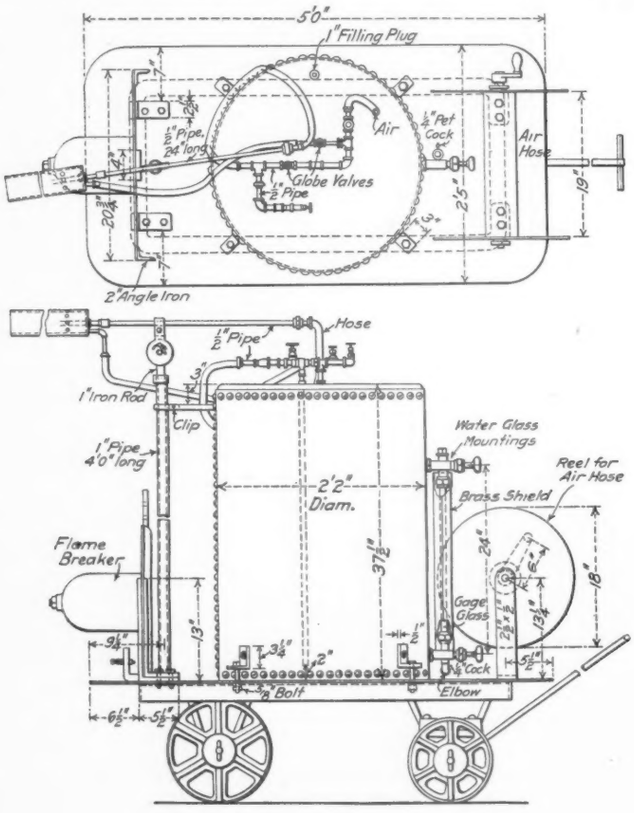


Fig. 4—Portable Oil Tank and Torch.

outside of the ring it is raised so as to give the additional ⅛ in. thickness at the outside, stops being used to insure the correct measurements. The outside face of the ring is not finished.

This method has reduced the time of finishing these rings by 50 per cent. over the old method. A duplicate set of tools are kept ready to replace any of the others, and wooden patterns of them are made so that all tools may be made alike and be maintained to the proper shape. The tool holders were forged from an old tire and are shown in detail in Fig. 2, together with the shape of the tools.

PORTABLE OIL TORCH FOR TESTING.

A complete heating arrangement for testing fireboxes and locomotive boilers is shown in Figs. 4 and 5. Although there have been other portable oil burners described in your columns, none have been quite as fully equipped as this one. It is provided with a reel for the air hose, and has a gage glass to show the amount of oil in the tank. The glass is graduated into fractions of gallons, so that the amount of oil used during a test may easily be ascertained. There is an adjustable rod at the rear end of the truck which holds the burner in position. A flame breaker or spreader is also carried on the truck so that it will always be at hand when needed. It is placed directly in front of the burner, and is used to diffuse the flame, and thereby spread the heat to

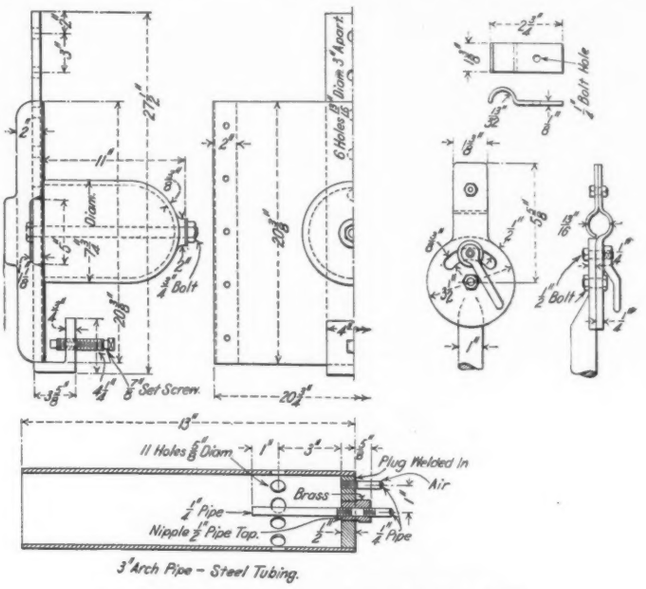


Fig. 5—Details of Flame Spreader and Torch.

all parts of the firebox. The construction is entirely of steel and iron, which makes a fireproof and durable combination.

The tank is held to the sheet iron floor of the truck by four ⅝ in. bolts, which pass through lugs on the side of the tank, so that they may be readily removed if it is desired to remove the tank from the truck. When the burner is not in use the air hose is neatly reeled, making the complete apparatus ready for immediate transfer to any part of the shop. The construction is clearly shown in the illustrations, Fig. 5 giving the details of the burner, the flame spreader and the arrangement for clamping the burner in position. This burner was devised by A. G. McClellan, master mechanic of the Chicago & Alton, at Bloomington, Ill.

TIRE CHUCK FOR BORING MILL.

A chuck that will grip all classes of tires on the outside tread while they are being bored on the inside is shown in Fig. 6. Four of these chucks are bolted at equal distances around the table of the boring mill, and after they have been once centered and located for the different sizes of tires, two ⅝ in. holes, not shown on the drawing, are bored through them into the table. Steel dowel pins are then placed in the holes made in the chuck so that it may be easily relocated thereafter. The jaw *B* is provided with the saw-teeth to insure a firm grip on the tire. One side is made with a radius to suit the largest driving tire, and the other to suit the largest diameter of the small tires. It has been found that this will provide a solid grip for all the differ-

ent sizes. The jaw is actuated by a hardened steel cam *C*, which rotates in the chuck, the bottom bearing being held in a hardened steel bushing. The cam is turned by a single ended box wrench and the top of the chuck is indexed to indicate the amount the jaw has been pushed in; by having each of the four indicators read the same it is assured that the tire is true with respect to the outside diameter. This is of special importance, for the tires are seldom received from the makers with the inside diameter bored true to the outside one, and by thus truing them at the beginning considerable metal is saved and less machine work is required on turning the tread after the wheels have been mounted.

When the chucks are located by the dowel pins they are clamped to the T-slots of the table by bolts fitting in the slots *A*, which are countersunk so that the nuts will clear the tire. When centering, the jaws *B* should be set to the average throw

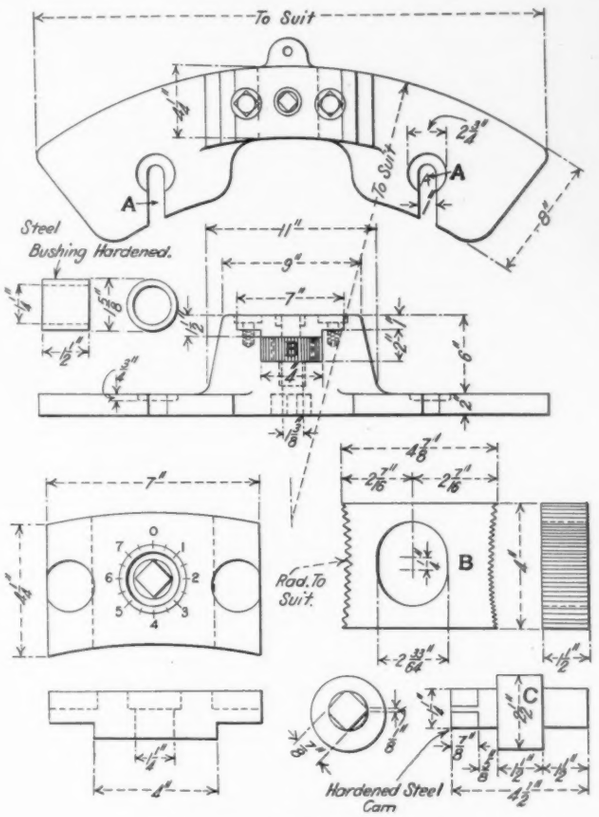


Fig. 6—Chuck for Holding Tires.

by the cam *C*, which would be at No. 2 in the indicator. It has been found that these jaws will hold the tire rigid enough for any cut when the indicator is anywhere between 0 and 4. With the jaws indexed, as described, it takes a very short time to center the tire; the operation is done in about two revolutions of the table. They also show how much variation, if any, there is between the tires of a set. For instance, if one tire was trued up with all the indicators at No. 1, and another with the indicators at No. 3 it will mean that one is ⅛ in. smaller in diameter than the other. This is a valuable check, and is made at the proper time. The chucks described herewith have been used for five years in a modern 20-pit shop, and are still giving splendid results. Care must be exercised when making the cams to have them all of the same throw. In the present instance each cam has a ⅛ in. throw, which will allow for a variation in the diameter of the tire, and so far the limit of the chucks has not been reached with American tires.

PNEUMATIC CLAMPS.

The two small air cylinders, or jacks as they might be called, shown in Fig. 7, are used for clamping guide bars to the table of a grinding machine. They operate on the long arm of levers which are fulcrumed on posts that are free to slide in the T-slots of the table. The arrangement is easily adjusted, being much quicker than the ordinary methods, and with a pressure of 100 lbs. the jacks will hold the bars sufficiently firm for grinding. The cylinders are 4½ in. in diameter, and the pistons have a

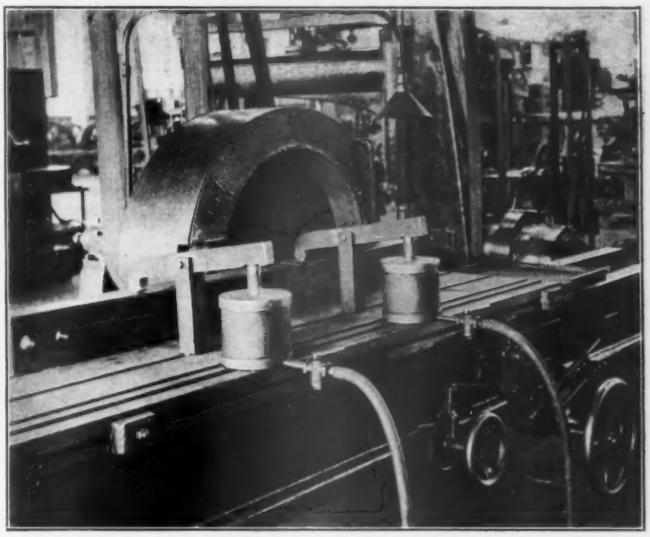


Fig. 7—Air Cylinders Used for Clamping Guide Bars to Grinding Machine.

stroke of 4½ in. They are similar in construction to the air cylinders shown in Fig. 10. If the available shop air pressure is less than 100 lbs. the cylinders can be made larger, or the length of the arms of the lever may be made to give the necessary clamping force on the guide bar.

MOLD FOR CASTING HUB LINERS.

A successful and inexpensive method of casting hub liners on driving wheels where no holes have been drilled in the hubs is

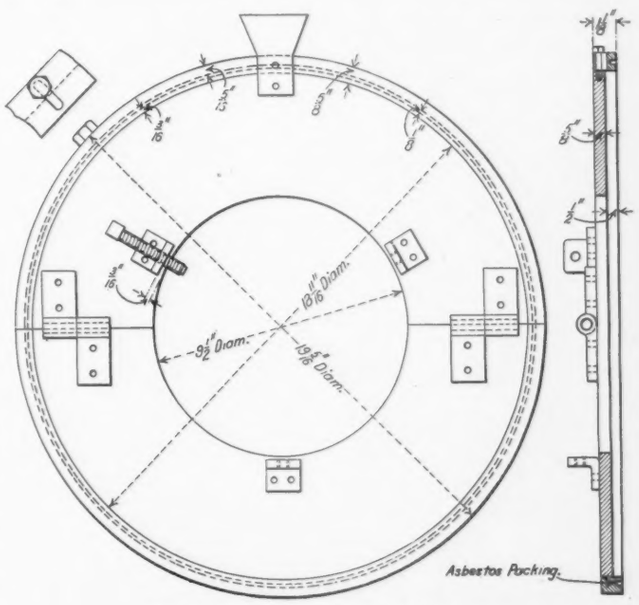


Fig. 8—Mold for Casting Hub Liners.

shown in Figs. 8 and 9. The mold is made of cast iron and is hinged in the middle. It is held to the axle by three set screws in lugs which are spaced equi-distant about the axle. The thickness of the liner is regulated by an adjustable ring on the circumference of the mold. This ring is held in place by four cap

screws located at equal distances around the mold, although only one is shown in the drawing. A groove in the ring is filled with asbestos packing, which provides a tight joint and prevents the metal from escaping. A hopper is provided at the top through which the metal is poured. With this arrangement it is unnecessary to machine or face off the liner after it has been

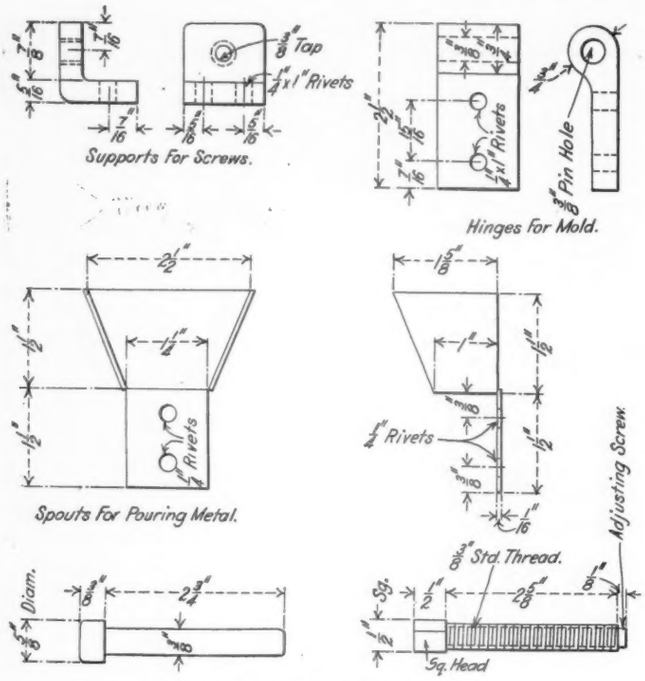


Fig. 9—Details of Hub Liner Mold.

cast. With a good grade of babbitt, engines have run 180,000 miles with only ⅛ in. of lateral wear.

ATTACHMENT FOR NUT FACING MACHINE.

It was found that with the ordinary nut facing machine it took as much time to stop the machine and remove the nut as it did to face the nut. To reduce the time for this operation the device shown in Figs. 10 and 11 was installed. It consists of an

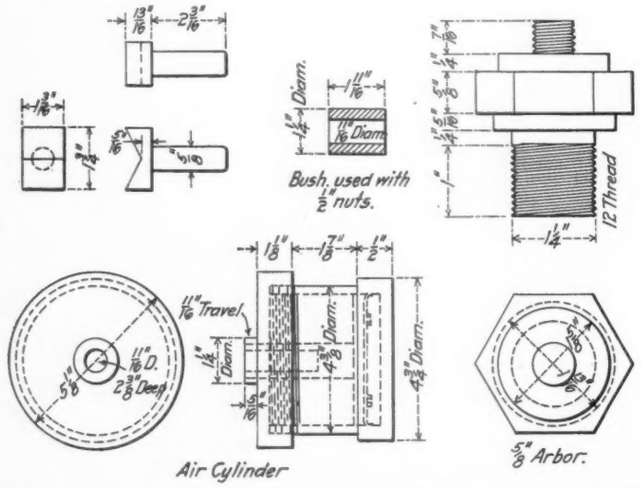


Fig. 10—Air Cylinder for Nut Removing Device on Nut Facing Machine.

air cylinder with a V-block fitting in the end of the piston rod. After the nut has been faced the machine is immediately reversed and the air is applied. The block will be forced against the nut and will keep it from rotating, unscrewing it from the arbor. A boy will soon become expert in handling the machine and will almost double the output.

A bushing regulates the height of the V-block above the end of the piston rod, so that it will just come in contact with the nut and not bring any pressure to bear on the arbor. For a ½ in. nut a bushing 1 11/16 in. high is required and for larger nuts correspondingly shorter bushings will be necessary. These bushings are stamped and kept in the tool room with the special nut arbors. The tool used in facing the nut can be ground so as to be used in countersinking the hole on the underside of the nut

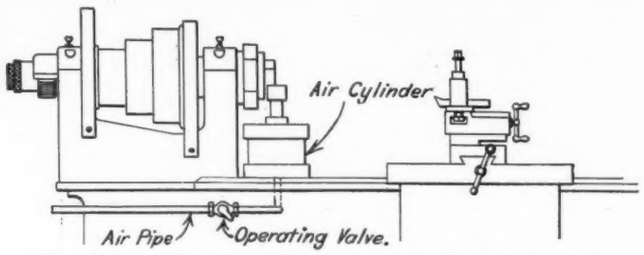
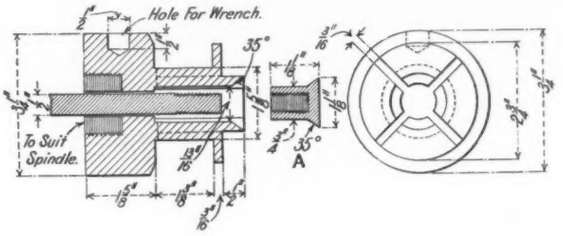


Fig. 11—Nut Removing Device for Nut Facing Machine.

about the length of the first thread. This will remove any burr that is made while facing and allow the nut to be easily applied.

SPRING CHUCK FOR FACING METALLIC PACKING.

The application of an air-spring chuck to a lathe is shown in Fig. 12. This chuck is used for facing metallic packing, steam pipe rings, or anything of that nature. The main body of the chuck is 3¼ in. in diameter, and has a ½ in. hole for applying or removing it from the lathe spindle. It is about 3¾ in. long, the outer portion being split in four sections, as shown, which allows it to be expanded to grip the inside of the work to be faced. The chuck is expanded by the cap *A*, which screws on



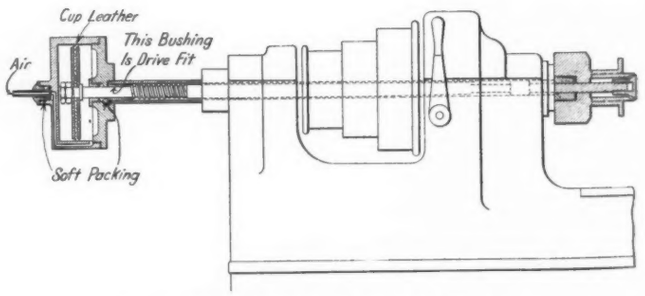


Fig. 12—Spring Chuck for Metallic Packing.

the end of the rod, extending through the spindle from the air cylinder, and fits in the conical surfaces on the inside of the split section of the chuck. After the packing ring has been placed on the chuck, the air is applied and the cap *A* forces the split sections out, gripping the ring. Different size chucks have to be used for each different diameter of ring to be faced, but where there are a large number of packing rings of the same diameter to be finished, the time saved by this method is very appreciable. when the air is exhausted from the cylinder the spring forces the cone plug out of the chuck, thus releasing the grip on the ring.

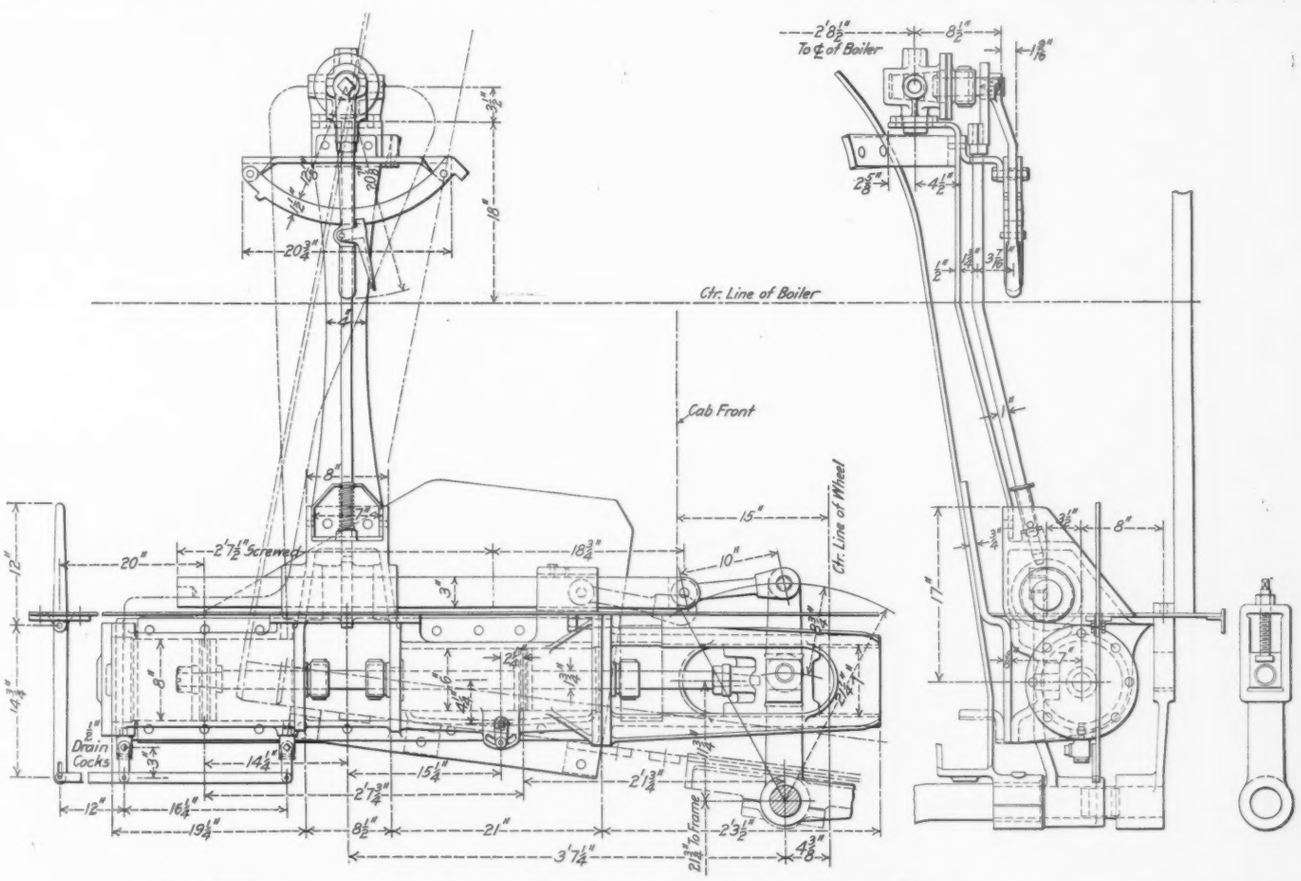
Live Stock Claims.—A western road paid $49 a day last year, for the settlement of live stock killed on the right of way.

SIMPLE MALLET FOR HIGH SPEED

An Articulated Locomotive with Four Equal Size Cylinders Grouped at the Center of the Wheel Base and Designed for Speeds Up to 50 Miles Per Hour.

BY G. I. EVANS.
Mechanical Engineer, Canadian Pacific Railway

Over two years ago an experimental Mallet compound locomotive having a number of unique features was designed and built by the Canadian Pacific. The general construction of the locomotive was fully discussed in the March, 1910, issue of the *American Engineer and Railroad Journal*, and a number of the more interesting details were illustrated in the August, 1910, issue. Since that time a number of other compounds of similar design, but embodying several improvements developed by the service of the first engine, have been built. These have given excellent results in pusher service and an attempt is now being made to develop a similar Mallet for road service which will give speeds up to 50 miles per hour without the rapid falling off in tractive effort, so pronounced in the compound engine. The first locomotive of this type was turned out of the Angus shops at Montreal, and was in service in October, 1911, making it the first simple Mallet to be put in use in this country.



Power Reverse Gear Developed on the Canadian Pacific.

A comparison of this locomotive with the first compound shows many changes. The most noticeable is found in the boiler construction, which in this case is an ordinary extended wagon top type with a superheater of the regular Canadian Pacific design. On the experimental locomotive there was a boiler with fire tubes 9 ft. 1 in. in length that terminated in a large combustion chamber in which was installed the superheater. Ahead of this was a section 8 ft. in length and somewhat smaller in diameter than the part back of the combustion chamber. This contained 281, 2 in., and 12, 2¼ in. tubes, and was used as a feed water heater. The superheater elements extended down in the combustion chamber from the headers at the top. The location, general arrangement and construction of the cylinders has not been appreciably changed in this new design, and the same type of power reverse gear has been retained. A long draw-bar has been substituted for the pin at the articulated connection, and of course the change from the compound to the simple has altered the steam pipe arrangement.

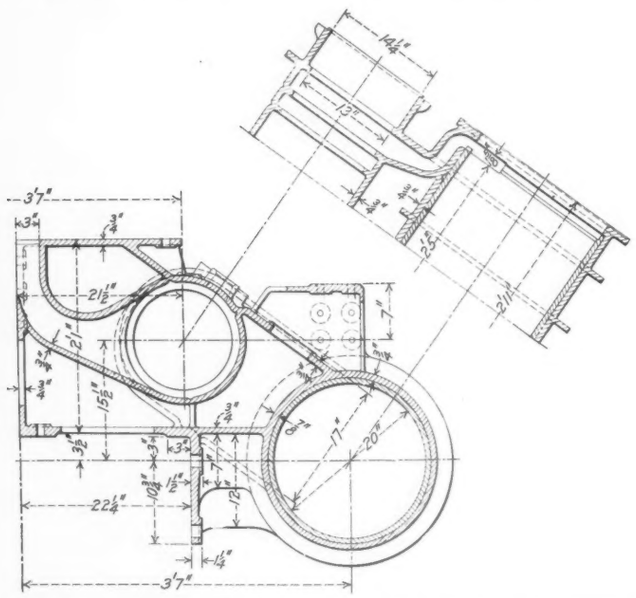
On account of bridge limitations, a total weight on drivers of 262,000 lbs. in working order could not be exceeded. The tractive effort of this and the first locomotive are practically the same, but the boiler capacity has been considerably increased. Great care has been necessary in the design of the various running gear parts to obtain a minimum weight and permit the use of the more powerful boiler without exceeding the weight limitations.

Cylinders.—The use of cast steel in the cylinders effected a

saving of 6,000 lbs. over cast iron. The walls are ¾ in. thick, and special attention was given to obtain uniform sections, as sound castings depend largely on this. The unusual shape at the junction of the walls was adopted to eliminate masses of metal and very little difficulty was experienced with the castings. Unlike the usual practice in making cast iron cylinders, the patterns were placed with the barrels standing vertically and a heavy riser on top of the barrel walls.

Cast iron bushings are used in the cylinders and steam chests. The rear engine cylinders are cast separately and bolted together with a single saddle casting bolted on top and to the boiler barrel. The same cylinder pattern was used for the front engine, but the saddle casting was omitted. The rear engine saddle is secured to the boiler shell by 50 tapered bolts 1¼ in. in diameter, driven from the inside. This system of fastening has been successfully used on the previous engines and gives practically no trouble.

Valve Gear.—A simple design of Walschaert valve motion is used with an inverted rocker carried by two bearings. This design has been successful on other Canadian Pacific locomotives where the center line of the valve is a considerable distance inside the eccentric crank. The most important consideration

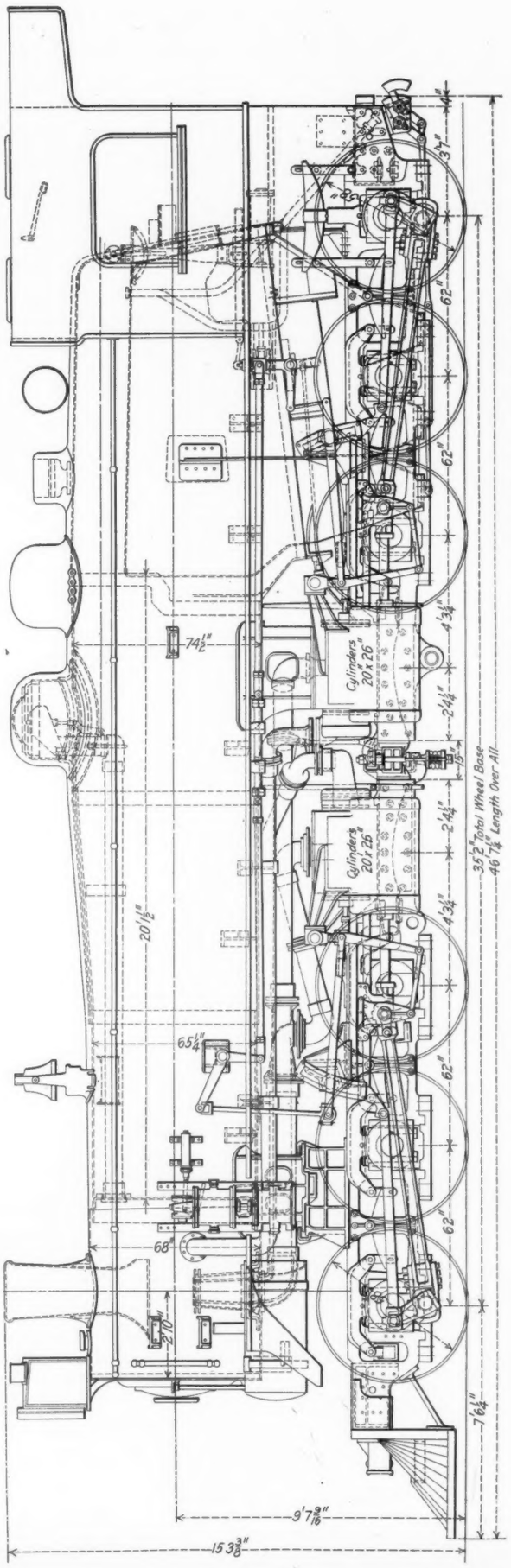


Cast Steel Cylinders; Four Duplicates are Used on the Canadian Pacific Mallet.

in a design of this kind is that the rocker be carried by two bearings set as far apart as possible to minimize wear and the effect of worn bushings. This condition is met by placing the outside bearing on a bracket bolted to a shelf on the cylinder while the inside bearing is carried by a combined steam chest head and rocker box bracket.

Reverse Gear.—Power reverse gear of a type similar in general design to that applied on the experimental compound locomotive is used. Improvements suggested by experience have been made. Air has been substituted for steam as the motive power, because of a tendency towards freezing with the former. An auxiliary steam connection is provided for emergency use.

The operation of this gear is simple. The three-way valve with the inverted lever is placed in the cab in a position convenient to the engineer. This lever, in running position, is always at the center of its quadrant, the position of the link blocks, whether in forward or back gear, and the cut-off in inches, being shown by an indicator. To put the engine in forward gear, the lever is moved forward, the first movement freeing the locking latch; air is then admitted to one end of the power cylinder and the piston moving forward causes the link

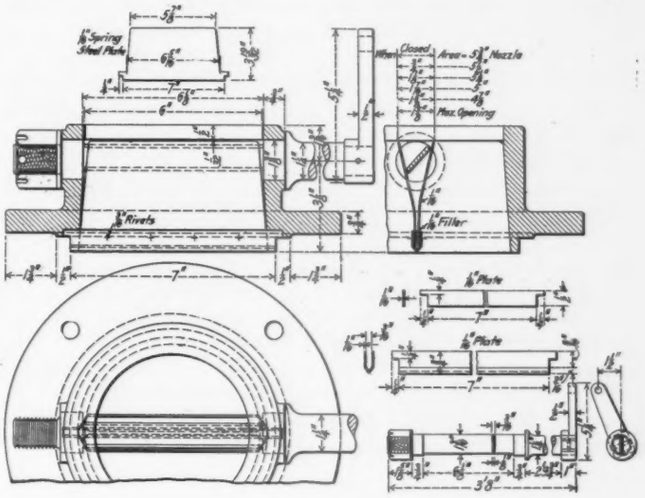


General Elevation of a Simple Articulated Locomotive with the Four Cylinders Grouped at the Center; Canadian Pacific.

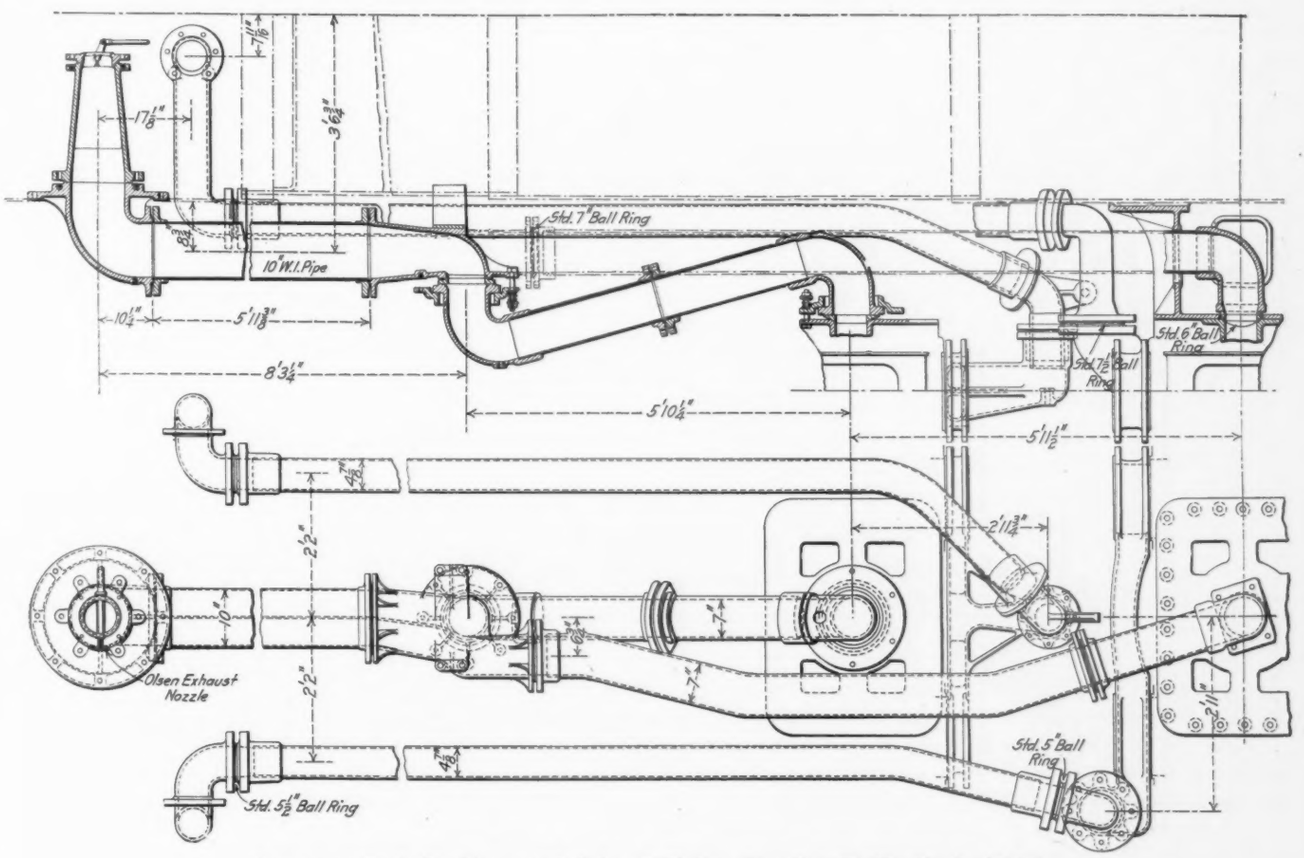
blocks to move to the desired cut-off. The speed at which the piston moves may be accurately regulated by a plug cock placed in the oil dash pot by-pass, the flow of oil from one end of the dash pot to the other permitting free or retarded movement as desired. Usually in cold weather a wide open by-pass is used on account of the greater resistance to movement of the various parts, while in warm weather its area must be constricted to prevent slamming.

When the desired cut-off point has been reached, the lever is drawn back, cutting off the air to the power cylinder, the piston of which stops moving, owing to the resistance of the oil. The final movement of the lever back to the center of its quadrant drops the locking latch, preventing creeping or any further movement of the link blocks. To put the engine in back gear, the lever is drawn back and the same procedure is followed. The locking device is simply a bronze nut, with notches on its rim, mounted on a six-threaded screw which is moved backward or forward by a lever connected to the power cylinder crosshead. The bronze nut is checked from forward or backward movement by thrust blocks carried up from the power cylinder casting. As the six-threaded screw passes through it and moves backward and forward, the nut spins one way or the other, and, if the locking latch is dropped into one of the notches on the rim of the nut, it cannot rotate, nor can the screw be pulled through it, in which case the gear is positively locked and can only be moved by pushing the lever in the cab from its mid position. Furthermore, it will be seen that a very small movement of the power cylinder piston will cause a considerable degree of rotation of the locking nut, so that a very close adjustment of the cut-off can be made. The arrangement of this device is clearly shown in the accompanying illustration.

Steam and Exhaust Pipes and Superheater.—One of the most carefully considered details of this engine was the arrangement of the exhaust from the two pairs of simple cylinders. It was at first determined to use a double exhaust pipe of the annular type with the inside nozzle 5½ in. in diameter and the outside one of an equivalent area. This arrangement was unsatisfactory and the engine would not steam freely with it. With the nozzles 5½ in. in diameter, only four distinct beats could be heard; these came from the inside nozzle and the effect on the fire of the thin film of steam from the outside nozzle was practically nil. Some improvement was effected by reducing the outside tip, but not sufficient to make the arrangement practicable.



Variable Exhaust Nozzle.



Arrangement of the Steam and Exhaust Piping; Canadian Pacific Simple Mallet.

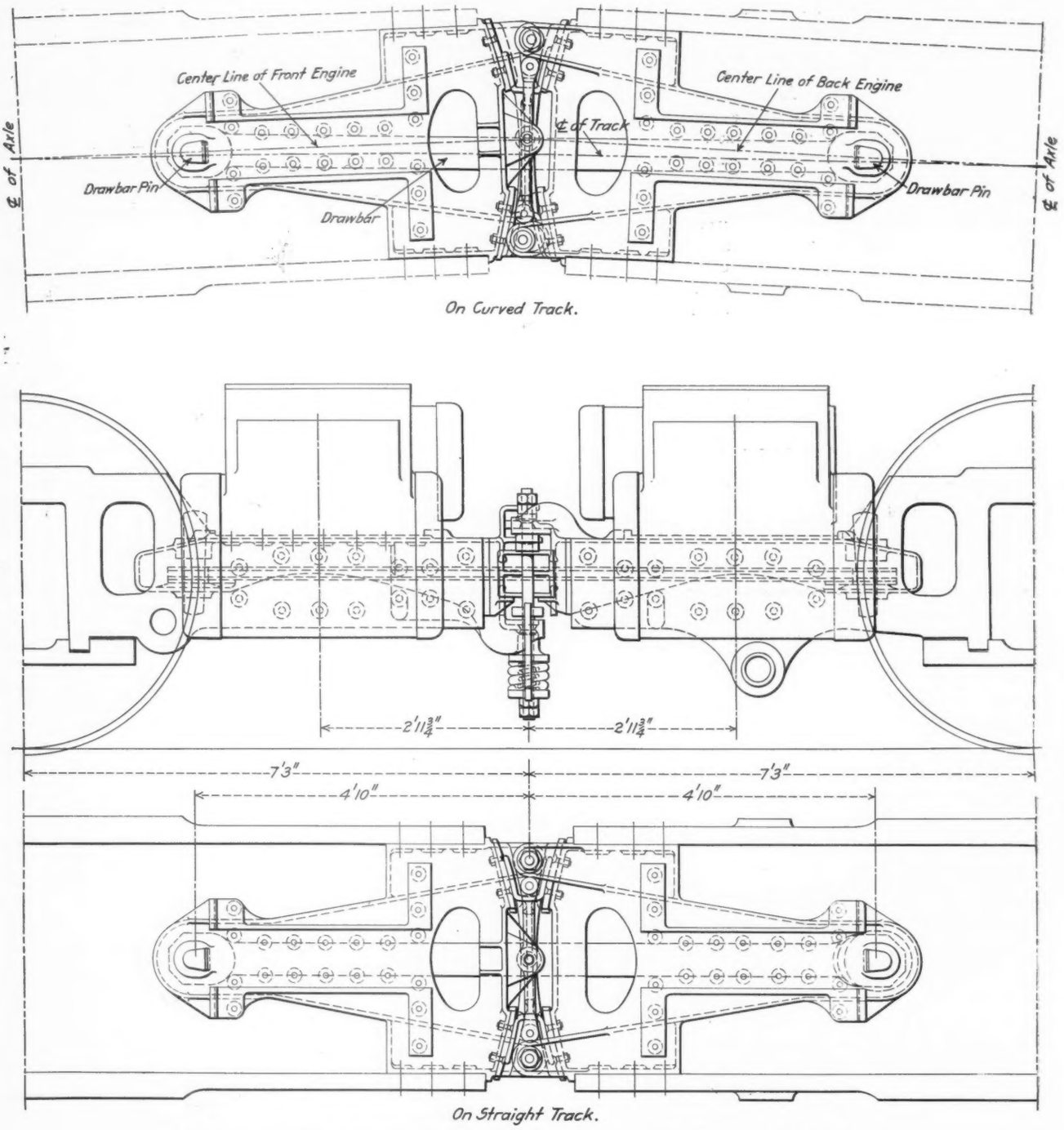
The next arrangement tried was two nozzles 5½ in. in diameter set side by side with their tips at such an angle as to make

their axes meet at a point 2 in. below the top of the stack. With this, the usual difficulty of filling one side of the stack only was encountered, and, although various forms and diameters of stacks were tried, both with draft pipes and inside extensions, it was not an entirely satisfactory arrangement. Square nozzles of various sizes were tried with results similar to the circular type.

Double nozzles were finally abandoned and a single, variable nozzle, with a minimum area equivalent to the area of a 6 in. circle, was substituted. This made an immediate improvement and was used on the engine after it went into regular service. The engineer could change the area of the tip when the engine was working by means of a lever in the cab connecting to an expanding bar in the nozzle casting. With skilful handling the back pressure in the exhaust was about 25 per cent. greater than with double nozzles.

The nozzle finally adopted for use is of the ordinary single type, 5½ in. in diameter, there being apparently no great advantage in the variable types, as the engine now steams freely and there is no danger of excessive back pressure by the careless use of the variable feature.

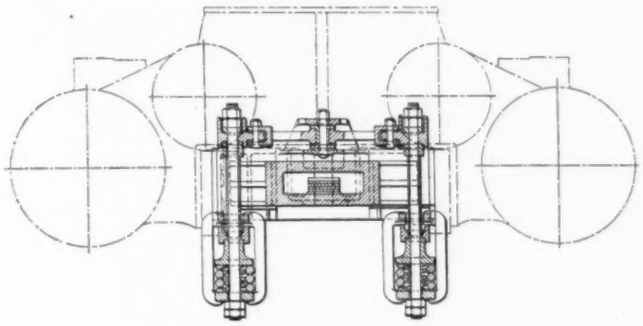
The exhausts from the front and back engines are brought together in a cast steel header with two inlets and a single outlet. This header is bolted solidly to the boiler barrel and the 7-in. exhaust pipe from the back cylinders extends from it to the exhaust connection on top of the cylinder. The exhaust pipe from the front engine connects to the header and cylinders by spring loaded ball rings, arranged both for



Type of Articulated Connection Employing a Long Drawbar; Canadian Pacific Mallet.

swiveling and sliding, as there is considerable movement at this point. Although both exhausts are brought together in the same header they do not combine, as there is a vertical dividing wall carried forward through the 10-in. wrought iron pipe, forming the front section of the exhaust pipe, and well up in the exhaust stand. The exhausts finally combine at a point just below the exhaust nozzle.

The superheater is of the fire tube type developed on the



Section of the Articulated Connection.

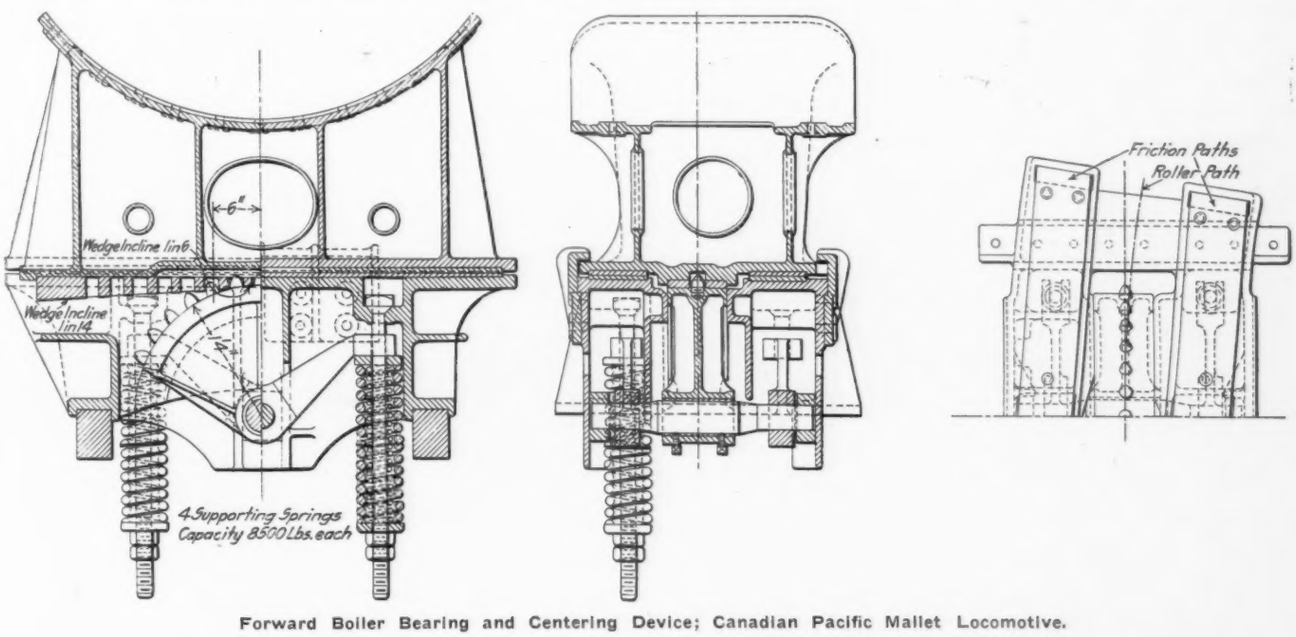
Canadian Pacific with separate saturated and superheated steam headers. Two steam pipes 4⅞ in. inside diameter, one on either side of the boiler, lead back to the cylinders; the pipe on the left side is rigidly fastened to the boiler and connects to the back pair of cylinders. The right-hand pipe delivers steam to the front pair of cylinders connecting to a steam header by means of a packet joint, bolted over each steam chest. Practically the only movement at this joint is a swiveling of about 5 deg., so that the use of an expansion sleeve is not required. There are, therefore, only one packed and two sliding ball ring joints in the whole steam and exhaust pipe system, as against five packed joints on the usual design of Mallets.

Frames.—The main frames are of cast steel 4½ in. wide, without splices, and the cylinders are bolted to slabbed extensions which are 3 in. wide by 15 in. deep. The front set of frames are thoroughly cross-braced by the front bumper, main boiler bearing, guide yoke and the cylinders, also by a filler underneath the cylinders, utilized as a connection between the front and back engines, the arrangement of which will be described later. The back set of frames are braced by the cylinders and filler, expansion plate and the back footplate.

On the experimental compound Mallet a pivot connection was used to connect the front and back engines, but, as the distance between the center pair of drivers is necessarily long on these engines, it was found that flange wear quickly developed on the wheels on either side of the cylinders. This will best be understood by reference to the diagram illustrating the present connection between the two engines, from which it will be seen that the pivot pin on the experimental compound engine is a considerable distance outside the center line of the track when the engine is traversing a curve and that, if the distance between the middle wheels is increased, a point will quickly be reached where the flange pressue would cause danger of derailment. On subsequent engines this difficulty was overcome by substituting the radial bumper shown in the illustration and a drawbar, the pins of which are located so as to straighten out the line of pull on curves and prevent excessive flange wear. The broad surfaces of the bumper blocks are manganese steel and wear very slowly. Slack can be taken up by driving in the pins, one side of which is wedge-shaped and acts like a connecting or side rod key.

When curving, the action of the wedge block is to assume a position with its center line directly over the center of the drawbar, the faces of the bumper castings on each frame remaining in contact over its entire surface. The purpose of the horizontal cross bolt is to prevent any tendency of either engine to move sideways independently of the other. Each end of the cross bolt is, therefore, fastened by a vertical pin to lugs cast on the bumper casting of the back engine, while the center connection is made to a similar lug and pin on the front engine bumper.

The weight of the boiler on the front engine is carried on



Forward Boiler Bearing and Centering Device; Canadian Pacific Mallet Locomotive.

a single support, located 19 in. ahead of the middle pair of drivers and of practically the same design as used on the experimental engine.* The top casting, bolted to the boiler barrel, rests on the lower casting, bolted to the engine frame, and is free to move sideways across it as the engine enters a curve. The weight of the boiler and attachments, resting on the front engine, is 45,800 lbs., 14,000 lbs. of which is carried by a fan-shaped roller, supported by two equalizers carried on four sets of helical springs, suspended by bolts from the lower casting.

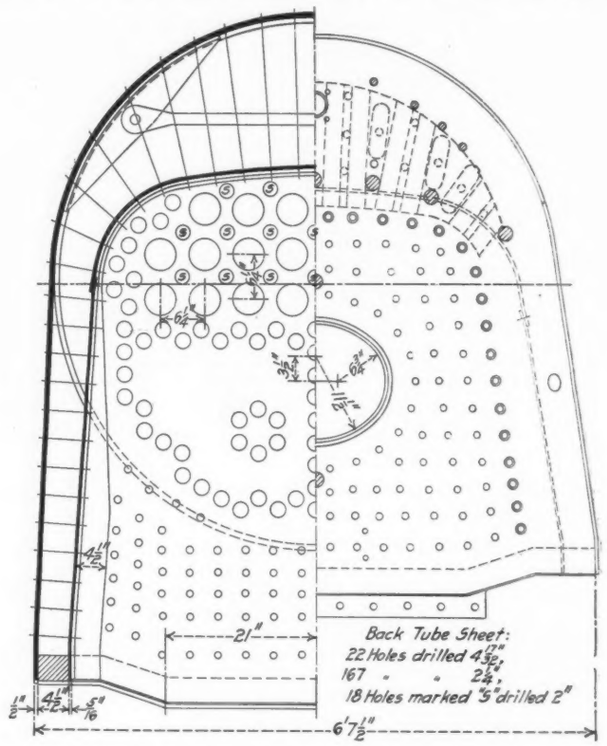
*See *American Engineer and Railroad Journal*, March, 1910, page 84.

The remainder of the weight, 31,800 lbs., is supported on four friction surfaces and the total guiding power of the front engine is, therefore, the sum of the rolling and frictional resistances. The total resistance may be entirely changed by the use of greater or less inclination on the roller blocks, which are carried in pockets in the upper casting. The roller pivot pin is guided in the vertical direction by grooves in the lower casting which allow it to rise and fall with the springs, but prevent its movement sideways no matter what the position of the top casting into which the roller teeth mesh, may be. The roller path on the upper casting consists of two steel blocks 28 in. long with a 1 in 6 incline, extending 6 in. on either side of the center and 1 in 14 incline on the remaining 22 in.

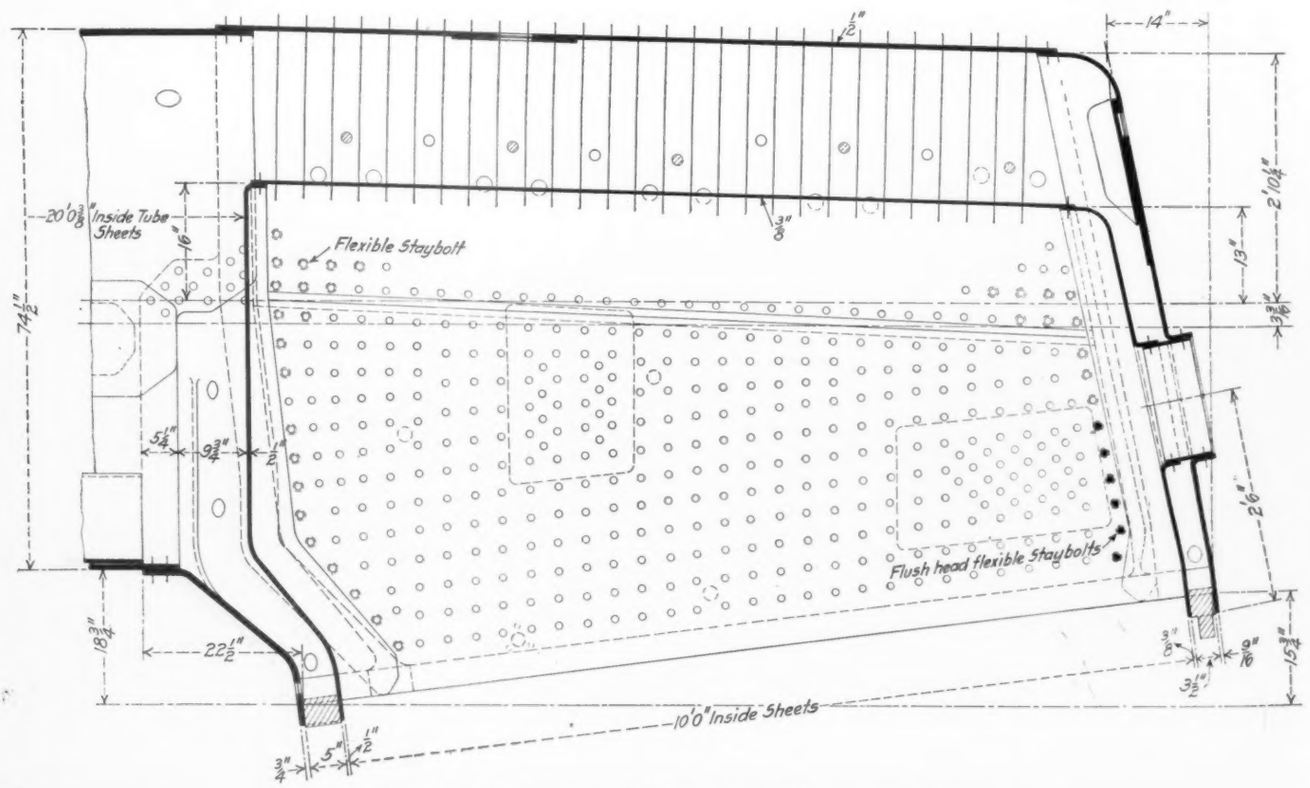
With this device the total resistance, when the boiler stands centrally with the frames, is about 5,000 lbs.; 2,375 lbs. rolling resistance from the 1 in 6 incline and 2,500 lbs. from the friction surfaces. As the boiler moves sideways through the first 3.3 in. the rolling resistance increases, due to the greater weight transferred to the roller by the deflection of the supporting springs, and the frictional resistance decreases. Any further roller movement is on the 1 in 14 incline, the resistance starting at 1,750 lbs. and increasing slightly as the deflection of the supporting springs increases. When straightening out after leaving a curve, the inclines exert a force to bring the boiler back to midposition. The object of the steeper incline at the center is to provide sufficient resistance to prevent a side swing of the boiler when running fast on straight track.

Boiler.—The boiler is of the radial stay type to which, in accordance with experience gained from other boilers of similar type, a system of cross-stays has been added above the firebox. There are nine cross-stays 2 in. in diameter secured by pin connections to T braces riveted to the roof sheet. The stays cross the firebox at a point about 6 in. above the crown sheet. Other features of the boiler design are the large radii on the firebox corners. The outside rows of staybolts are placed at a considerable distance from the edges of the sheets with the object of allowing greater flexibility and preventing breakage of the end rows.

The ashpan applied is of a type adopted after extensive experience with practically all forms of self-clearing pans under all conditions of climate and service. There are two hoppers with inclined swinging doors operated by levers from the side of the engine. The doors are of malleable iron



End Elevation and Section of Firebox; Canadian Pacific Mallet.



Section of the Firebox on the Canadian Pacific Simple Mallet.

with cavities in which steam may be turned to thaw them free in cold weather. Sufficient air space is provided by the usual system of openings under the firebox ring, protected by deflector plates, to prevent the dropping of live coals or sparks.

The general dimensions, weight and ratios follow:

General Data.

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	57,500 lbs.
Weight in working order	262,000 lbs.
Weight on drivers	262,000 lbs.
Weight of engine and tender in working order	395,000 lbs.
Wheel base, rigid	10 ft. 4 in.
Wheel base, total	35 ft. 2 in.
Wheel base, engine and tender	60 ft. 9½ in.

Ratios.

Weight on drivers ÷ tractive effort	4.55
Total weight ÷ tractive effort	4.55
Tractive effort × diam. drivers ÷ heating surface*	884.00
Total heating surface* ÷ grate area	64.00
Firebox heating surface ÷ total heating surface*, per cent	4.90
Weight on drivers ÷ total heating surface*	69.50
Total weight ÷ total heating surface	69.50
Volume both cylinders, cu. ft.	19.00
Total heating surface* ÷ vol. cylinders	198.00
Grate area ÷ vol. cylinders	3.10

Cylinders.

Kind	Simple
Number	4
Diameter and stroke	20 in. x 26 in.

Valves.

Kind	Piston
Diameter	11 in.
Greatest travel	6½ in.
Outside lap	1 in.
Inside clearance	1/16 in.
Lead	¼ in.

Wheels.

Driving, diameter over tires	58 in.
Driving journals, main, diameter and length	9½ x 12 in.
Driving journals, others, diameter and length	9 x 12 in.

Boiler.

Style	Wagon top
Working pressure	200 lbs.
Firebox, length and width	120 x 70⅞ in.
Firebox plates, thickness	T., ½ in.; B., 7/16 in.; S. & C., ⅜ in.
Firebox, water space	S., 4½ in.; F., 5 in.; B., 3½ in.
Tubes, number and outside diameter	167—2¼ in.; 18—2 in.
Flues, number and outside diameter	22—5¼ in.
Tubes, length	20 ft. ⅜ in.
Heating surface, tubes	2,765 sq. ft.
Heating surface, firebox	185 sq. ft.
Heating surface, total	2,949 sq. ft.
Superheater heating surface	548 sq. ft.
Grate area	59 sq. ft.

Tender.

Tank	Semi water bottom
Frame	13 in. & 10 in. channels
Wheels, diameter	36¼ in.
Journals, diameter and length	5½ x 10 in.
Water capacity	5,900 gals.
Coal capacity	12 tons

*Equivalent heating surface = 2,949 sq. ft. + (1.5 × 548 sq. ft.) = 3,771 sq. ft.

CENTRAL OF NEW JERSEY ICE CAR

Ice must be carried in well insulated cars that are securely braced to withstand the impacts due to the shifting of the load. A load of ice is more liable to shift than almost any other commodity and the car must have a strong end construction. The floor must be made water proof to prevent water from leaking through and rusting or rotting the underframe. Two hundred and fifty cars in which these requirements have been carefully considered have recently been delivered to the Central Railroad of New Jersey by the Standard Steel Car Company, Pittsburgh, Pa. They were designed jointly by the engineers of the railway company and the builders.

The car is 38 ft. 4 in. long over the striking plates and has a capacity of 80,000 lbs. The inside is 36 ft. long x 8½ ft. wide x 8 ft. high, providing a space for about 140,000 lbs. of ice, but it is impractical to load such a car to its full cubical capacity and only about 80,000 lbs. can be loaded conveniently. The construction of the body of the car is clearly shown in the accompanying drawings. There are two belt rails, 3 in. x 4 in., extending along the sides of the car and two 4 in. x 4 in. rails at the ends of the car. The end corner posts and the two intermediate end posts are 4 in. I-beams, with fillers of yellow pine. The intermediate posts and braces along the sides of the car are 3 in. x 5 in. yellow pine, while the door posts are of white oak.

The details of the side door, which is provided with the Unoit car seal, are clearly shown. It has three layers of hair felt and two air spaces, one ⅞ in. and the other 2 1/16 in. thick for insulation. The sides and ends of the car have yellow pine lining grooved and tongued; it is 1¼ in. thick at the sides and 1¾ in. thick at the ends. One layer of hair insulation is placed on both sides of the air space which is 3 in. wide at the sides and 4¼ in.

Ice Car of 80,000 lbs. Capacity; Central Railroad of New Jersey.

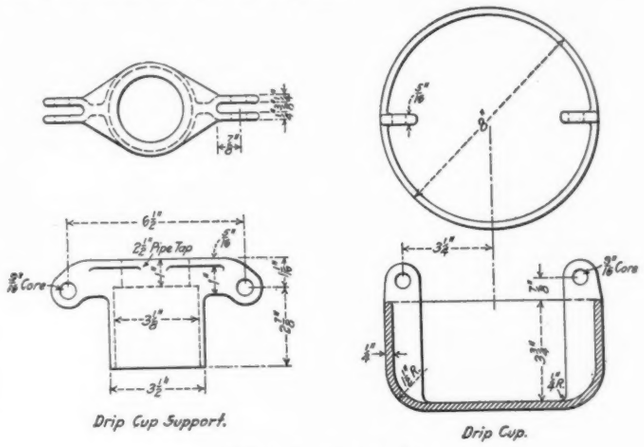
wide at the ends. The roof consists of two layers of yellow pine boards 13/16 in. thick; there is also a ceiling of 13/16 in. lining boards which is covered by a layer of hair insulation fastened to the underside of the carlines.

One half of the cars are provided with the Hutchins improved plastic roofing while the other half has the Lehon Company's roof. This special roofing is placed between the two layers of boards.

The junction of the floor with the sides and ends of the car is water-proofed by a zinc angle, 0.4 in. thick. The flooring of yellow pine is ship lapped and is 2⅜ in. thick. On the underside of the floor a three-ply water-proofing paper is placed over the stringers and center sills to protect the underframe from any moisture that may permeate through the floor. Four air seal drip cups of a special design shown in one of the illustrations are used to drain the car.

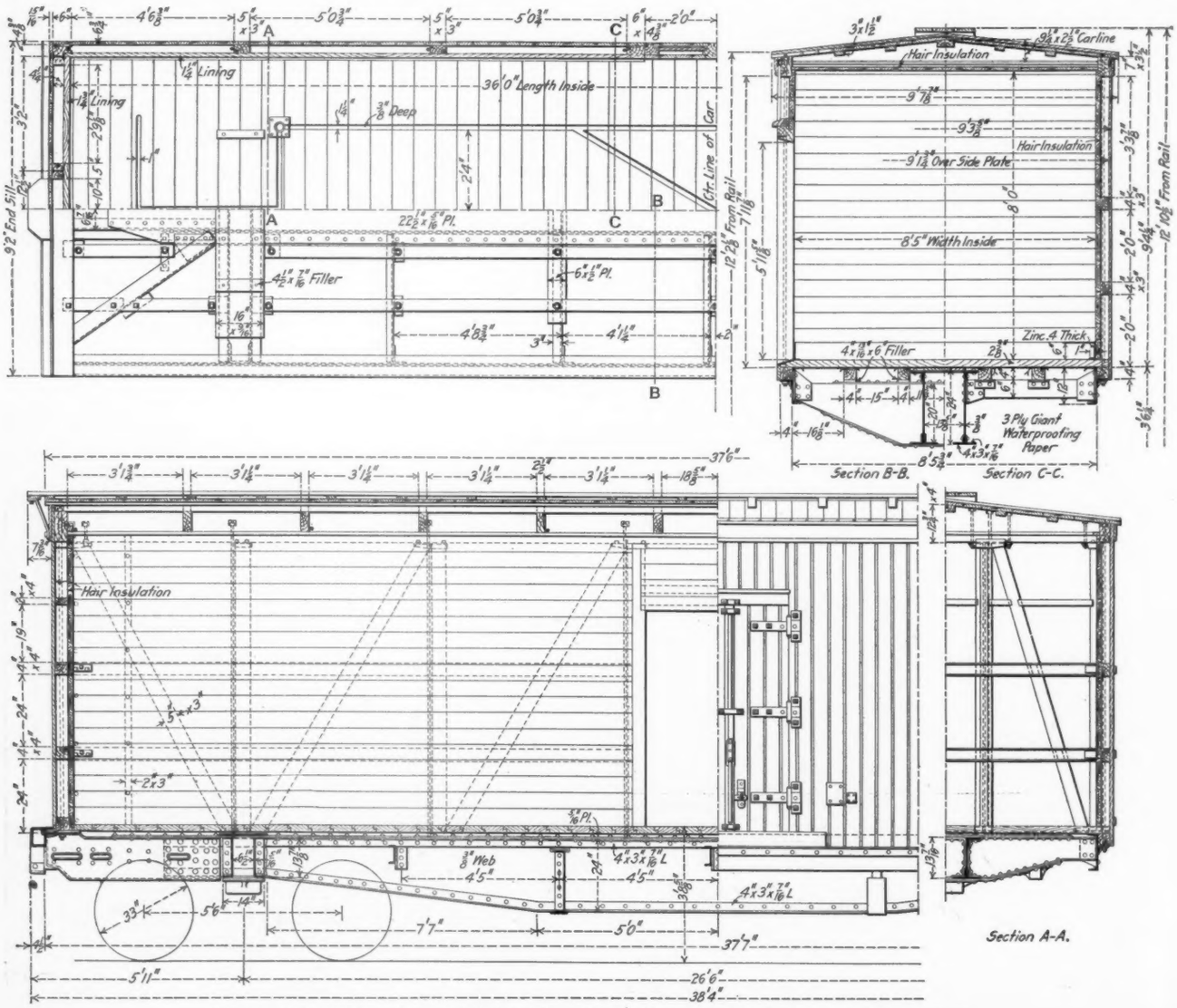
The center sills are I-beams 24 in. deep at the center and tapering to 13 7/16 in. at the ends. Two needle beams extend across the car 4 ft. 5 in. each side of the center, while three 6-in. channels serve as cross-bearers. The end sills are 12-in. channels with their flanges turned inward. The side sills are also made of 12-in. channels with the flanges turned inward and with a 4 in. wooden sill on the outside supported on angle irons.

The striking plate is of special construction, being designed by G. W. Rink, mechanical engineer on the Central Railroad of New Jersey. Its special feature is the coupler carrier, which is so designed that when one surface is worn by the coupler yoke it can be inverted or renewed, providing a new surface for wear and prolonging the life of the plate.

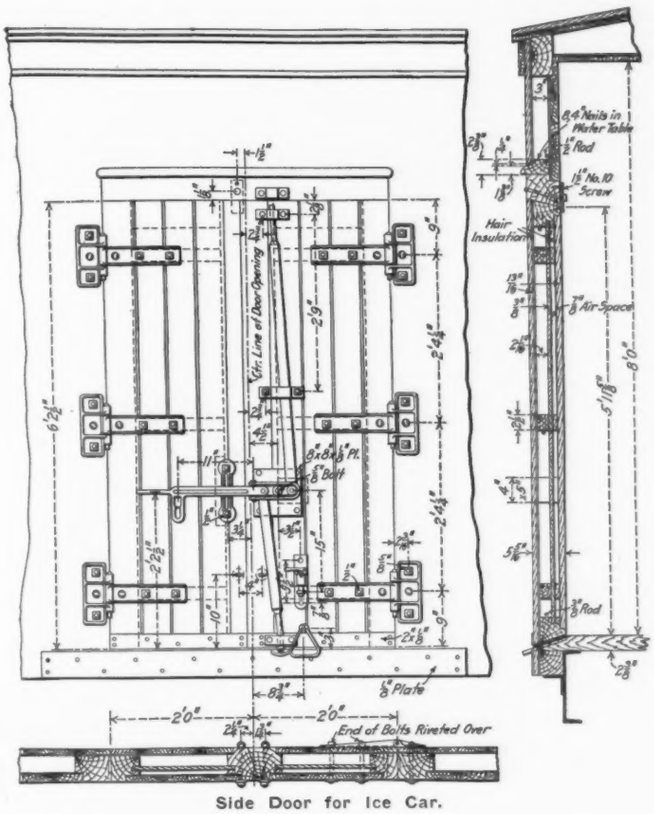


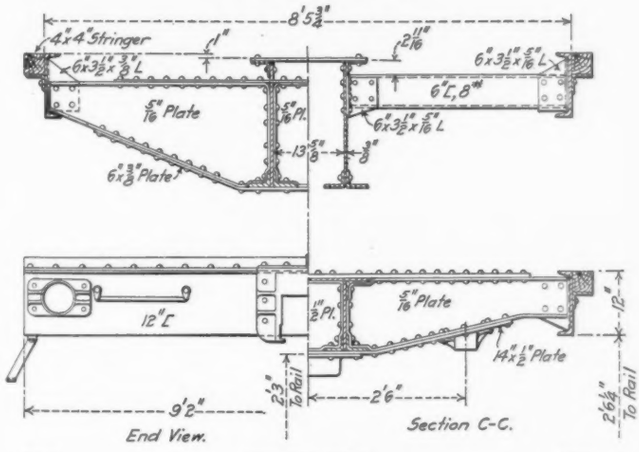
Drip Cup for Ice Car.

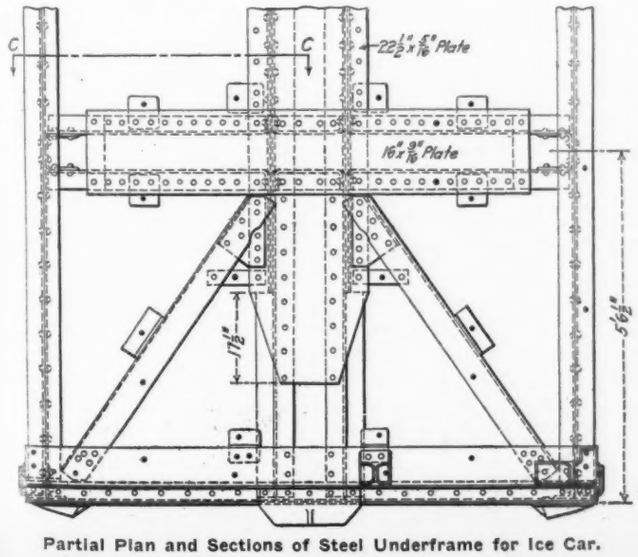
Four different kinds of draft rigging have been applied as follows: The Farlow-Westinghouse on 50 cars; the Farlow-Gould on 50; the Farlow-Session on 50 and the Miner friction,



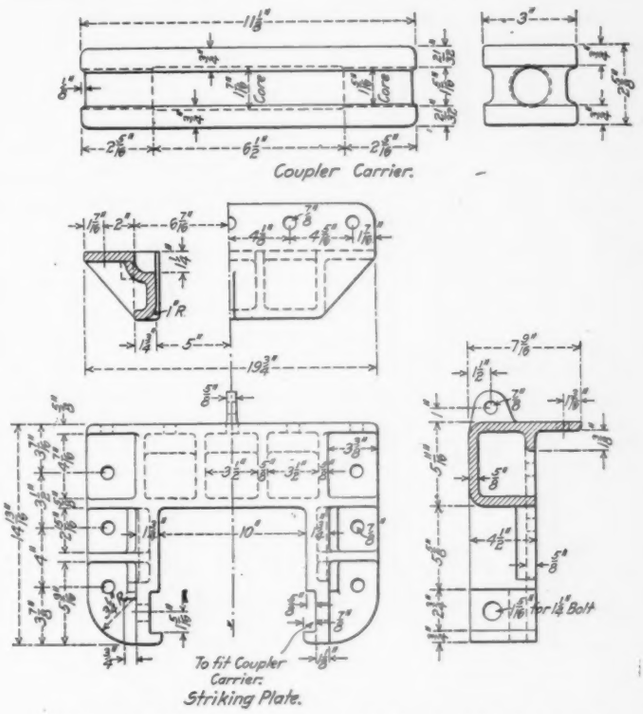
Plan and Elevations of an 80,000 lb. Capacity Ice Car; Central Railroad of New Jersey.







class A-7, on 100 cars, the idea being to test out these different types of draft gear in this particular service. The trucks are of the cast steel side frame type made by the American Steel Foundries and the truck bolsters are also made of cast steel. The truck frames are provided with removable wearing plates at the opening for the bolster. The wheels are 33 in. in diameter and



Striking Plate for Ice Car with Special Design of Coupler.

weigh 675 lbs. The underframe and the trucks are designed for 88,000 lbs. capacity each, in addition to the light weight of the car body. This provides a leeway of 8,000 lbs. on the rated capacity of the car.

EFFICIENCY OF RAILWAY EMPLOYEES

W. W. Finley, president of the Southern Railway, presented a paper on "The Interest of Railway Employees in Greater Efficiency of Operation" before the Richmond Railroad Club, April 4, 1912, in which he brought home the part which each individual employee plays in the development and earnings of a railway. He used the term "efficiency of operation" in its broad sense, including all branches of railway work and not restricting it to what is commonly known as the operating department. The following is taken from the paper:

"The formulation of plans for obtaining greater efficiency of operation is the duty of those of us who are charged with railway management, but each of us can contribute to the success of such plans by making his individual service efficient. All that is necessary is that the individual employee shall know his duty and do it to the best of his ability. He should not only endeavor to perform his specific duties as effectively as possible, but he should seek at all times to co-operate intelligently and helpfully with all other employees in his own department and in other departments. I do not mean by this that he should seek to thrust his aid on others. If he does he will probably make a nuisance of himself, and if he spends his time attending to the business of others he is in danger of neglecting his own duties. There are, however, many opportunities for helpful co-operation and effective teamwork.

"The highest efficiency of management consists in securing safety and efficiency of service by so conducting operations that expenditures will bear a fair and reasonable relation to the

revenues of the company. Therefore, in the maintenance of the property and in conducting its operations otherwise, the factor of consistent economy should be ever in mind. The intelligent ordering and use of materials in roadway maintenance; the effective use of materials in shop and other operations; careful watch on storehouse supplies; close attention to fuel consumption; close check on and the proper use of stationery and other station supplies—these are only some of the things tending to greater efficiency.

"A phase of the general problem of greater efficiency with which the employees of the operating department are chiefly concerned and falling within the category of personal injuries—which places so heavy a burden on the railways of today—is the prevention of accidents. Some railway accidents are unavoidable by any human means. Others are due to the carelessness or recklessness of passengers, trespassers, or others not in the employ of the companies, and their prevention is often beyond the power of the employees. Still there are other accidents that are clearly preventable.

"A recent writer on this subject has said that 'every preventable accident is due to some failure or insufficiency of material, method, or man.' Materials and methods are largely in the control of the management, but shortcomings of the human element can be corrected only by the men themselves, and back of failures which, on their surface, may seem to be attributable to materials or methods, there may be faults of men. This is manifestly the case where an accident results from a defect in material which it was the duty of some one to detect and report, and we all know that the effectiveness of methods is largely dependent upon the attitude toward them of the men by whom they must be carried out.

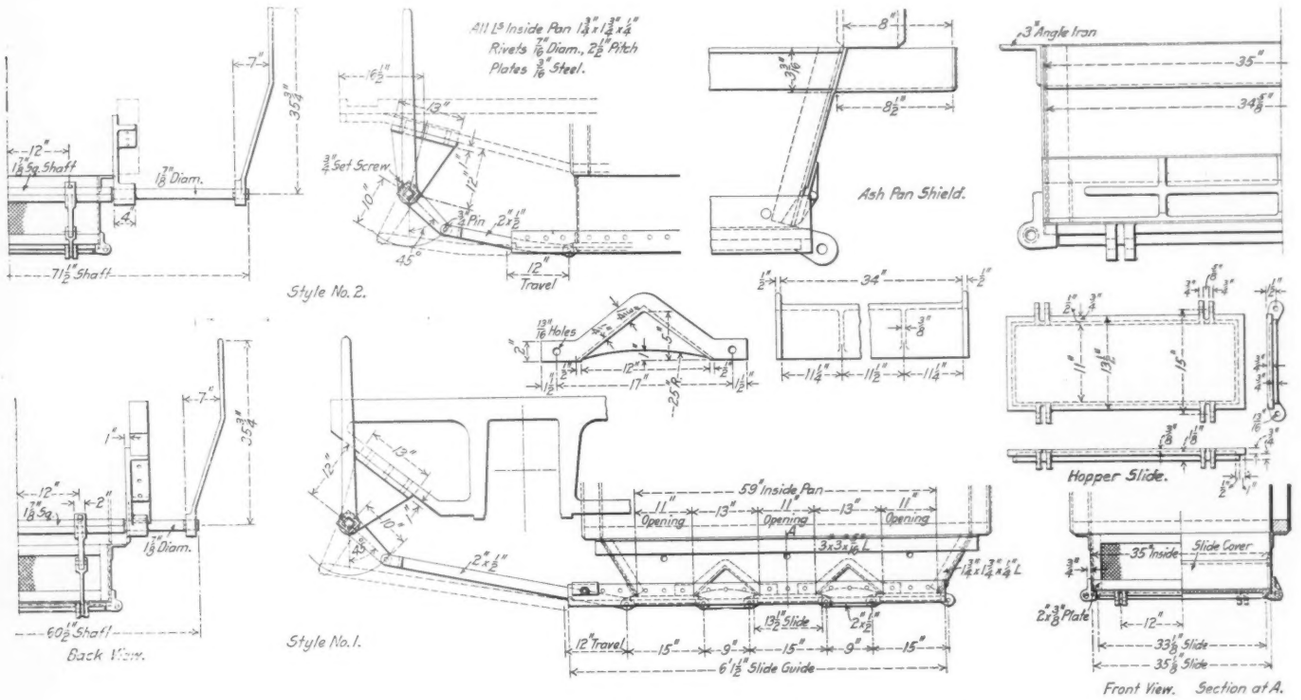
"The absolute elimination of preventable accidents should be an end for which railway managers and employees should strive for two reasons; first, because it is our primary duty to the public to safeguard the lives and property entrusted to us for carriage; and, second, because of the large hole which payments on account of personal injuries and loss and damage make in the fund in which, as we have seen, owners and employees are alike interested."

ASH PAN FOR NARROW FIREBOX

BY P. F. SMITH,
Mechanical Engineer; Chicago, St. Paul, Minneapolis & Omaha; St. Paul, Minn.

The three-hopper ash pan shown in the accompanying illustration was designed to comply with the federal law, and has performed excellent service on eight-wheel engines, and may be used on any type of engine with a narrow firebox and deep water legs. The castings are so designed that they may be used on all engines of this type, as the different lengths of grates are taken care of by the slope of the ends of the ash pans. The arrangement consists of three slides connected to each other by links of 2 in. x ½ in. iron. They operate on cast iron guides, cored out for steam heat, to keep the slides from freezing in cold weather, but in the experience of the past three years steam heat has not been found necessary. The slides themselves are made of ⅜ in. cast iron, and are machined on the ends where they slide in the guides.

Between the slides are the castings, so designed as to deflect the ashes on to the slides. All the parts used in the pan are drilled by means of jigs, and without considering the first cost of the patterns one of these pans can be made for $20. The cost of maintenance is not greater than the old style pans, and the only breakage that has occurred on 150 engines that have been equipped with them has been due to obstructions between the rails. When these pans were first tried out a perforated plate was used for the ends, but it was found that this became blocked up by frost and snow in cold weather, and for this reason the ends were replaced with tank steel shields, which are used both in summer and winter.



Three-Hopper Ash Pan for Narrow Fireboxes.

Economy.—It was recently suggested by an officer of the Rock Island Lines that the length of the ordinary pin used in pinning papers together could be shortened 1/16 in. On the face of it this seems to be a very small matter, but it was found that 921,000 pins could be saved per year, which would save the company $81. This is along the line of the campaign on this road for each employee to save a nickel a day.

AN IDEAL BOILER TUBE DEPARTMENT

Arrangement of Modern Equipment to Handle 450 Tubes a Day, at a Labor Cost Not to Exceed Three Cents Per Tube, from Engine to Engine.

BY L. R. POMEROY.

An extensive investigation of the methods employed in the repairing of locomotive boiler tubes by the various railway shops reveals the fact that in many cases the same attention has not been given to standardizing the tube repair operations that has been devoted to providing modern tools and efficient organization for machine shop operations.

In shops where but ten to fifteen locomotives per month are given heavy repairs, the number of tubes required to be handled daily is so small that the ordinary box flue-rattler, more or less antique in pattern, is sufficient to keep up with the demand, but it is by no means efficient and gives a high labor cost per tube cleaned. When the shop is of a size that requires the handling of 400 or more tubes a day, the question of giving the tube department adequate consideration is of decided importance. This number of tubes is beyond the capacity of the home-made box-rattlers or cleaners under average water conditions.

It is quite a surprise to find, even in the larger shops, how little effort has been made towards providing the best apparatus suited to the purposes and arranging the sequence of operations so as to reduce the cost for each tube to an economical, or rational figure. Data on costs show that the extreme usually varies from five to eight cents per tube, from the engine in the erecting shop, through the tube department and back to the engine. With modern apparatus and some attention given to the

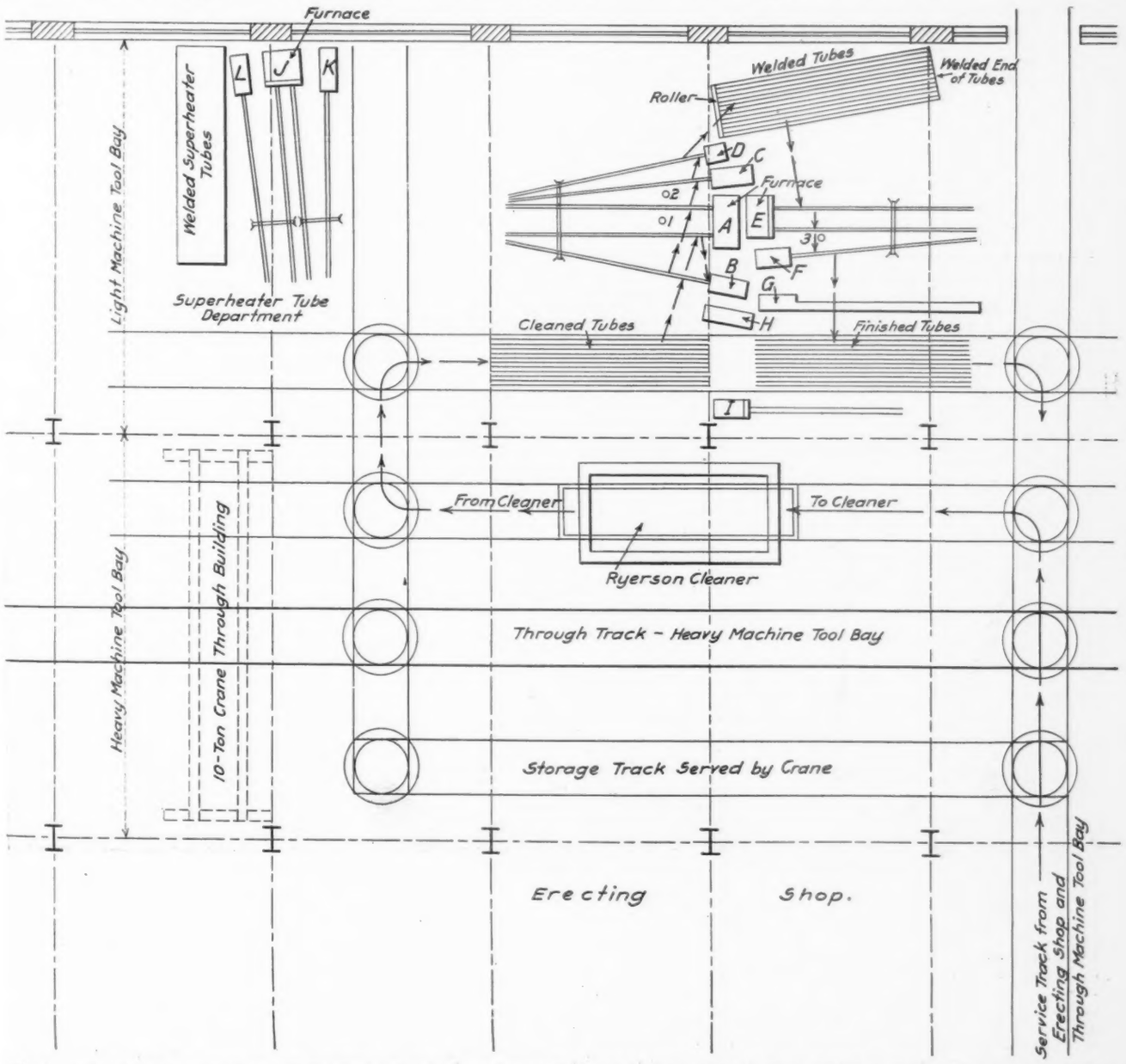


Fig. 1—General Arrangement of a Boiler Tube Repair Department Designed to Give a Labor Cost of Not to Exceed Three Cents a Tube.

arrangement of the tools, these costs need not run over three cents a tube where 400 to 500 tubes are handled daily. In fact, one reputable concern manufacturing well known appliances for this work does not hesitate to guarantee this figure with the proper tools and arrangement.

The following study is intended to outline a flue department, where these results may be easily obtained. This arrangement is only typical, and can be modified to suit other conditions if the apparatus and sequence of the operations is practically preserved.

The general arrangement of the apparatus and the track connections is shown in Fig. 1. This is based on the prevailing type of shop, where the erecting shop and boiler department are under the same roof and where the machine shop is placed alongside the erecting shop. This plan is suited to either a transverse or longitudinal track arrangement in the erecting shop. The figures, *1*, *2* and *3*, on Fig. 1, show the stations of the workmen performing the consecutive operations. The letters designate the machines as follows:

A.—Welding furnace, preferably of the oil type.

B.—Hot-saw and expander provided with safe-end magazine, where the safe-ends are automatically delivered.

C.—Improved welder. Made adjustable to handle tubes from 1½ in. to 6½ in. in diameter.

D.—Tube swedger.

E.—Second oil furnace.

F.—Hot-saw and expander.

G.—Tube tester. (A large number of roads are doing away with the testing of tubes as they have found that the weld, made by means of the modern roller type machine is so uniformly satisfactory that it is safe to omit the test, although it has been found that where the welding has been done by pneumatic hammers the percentage of poor welds is so large as to make the use of a flue tester necessary.)

H.—Rack for storage of safe-ends.

I.—Safe-end machine for cutting and scarfing tubes.

J.—Furnace for heating superheater flues.

K.—Cut-off saw and expander for superheater flues.

L.—Welder and swedger, designed for flues from 2 in. to 6½ in. in diameter. (This machine should be adapted for welding the 4½ in. safe-ends on the small end or full size 5½ in. on the opposite end of the superheater flue. After the required amount of flues are safe-ended and welded, the adjustment can be changed to perform the operation of swedging and the flues again put through the machine and swedged. This involves another heat, but as the number of superheater flues to be handled per day is so small, it may be advisable, or economical, to use one machine in the manner described, rather than to have a separate machine for swedging. It is, however, obvious that should the number of tubes to be handled warrant a second machine, the operations would be accelerated, especially as one heat could be obviated.)

The method of procedure is as follows: As the tubes are withdrawn from the boiler, in the erecting shop, they are placed

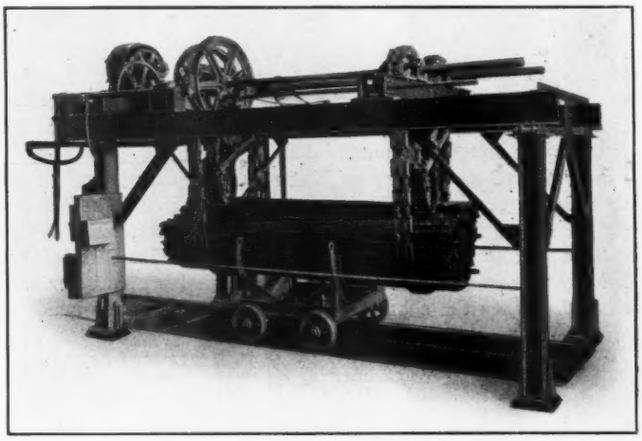


Fig. 3—Ryerson Overhead Type Flue Cleaner.

on a flue carrier or car, Fig. 5, conveniently located at the front end of the locomotive, as represented in Fig. 2. When the carrier is loaded it is picked up by the crane, carried to the boiler shop, and set down on the cross service track, which is

Fig. 2—Removing Tubes from the Boiler and Loading on the Flue Car in the Erecting Shop.

usually located between the erecting and the boiler shops. Such a service track at this point is quite common to both the longitudinal and transverse types of shop. The tube car is pushed along this track, in the direction of the arrows, to the track on which the tube cleaner (Fig. 3) is located and then in the cleaner. The tubes, comprising a complete set, are first lifted from the car by the suspending chains as shown in Fig. 4. The car is pushed clear of the machine and the tubes are lowered

in the pit and cleaned. The same chains that raise and lower the tubes in the pit perform the rolling action for cleaning.

After being cleaned, the tubes are raised from the pit, the tube car is pushed under them and they are lowered on it. The car is then pushed in the direction indicated by the arrows to the station marked "Cleaned tubes."

Man No. 1 takes a tube from the pile on the car, and without turning inserts the firebox end in the furnace *A*. When heated the scored or damaged end is cut off by the saw of machine *B*. The tube is then placed in the clamps and on the mandrel alongside the saw on this machine where it is expanded and placed on a safe-end. The machine is provided with a magazine from which the safe-ends are automatically fed down in place at the side of the expander. The work so far has required but one heat. The tube, with safe-end attached, is then returned by the same man to the furnace *A* for a welding heat. When heated, man

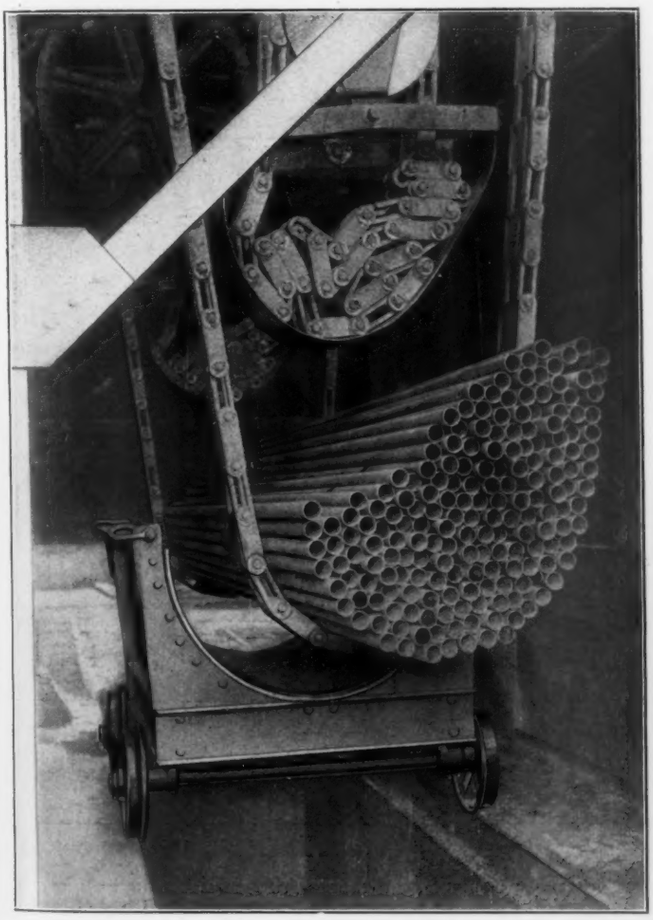


Fig. 4—Removing or Loading Flues at the Cleaner.

No. 2 takes it from the furnace and welds it on the welder *C*, after which, with the same heat, he swedges the end on machine *D* to accommodate the copper ferule. It is then delivered to the rack marked "Welded tubes."

Man No. 3 takes the tube from the welded pile and heats the smokebox end in furnace *E*. It will be noted that he does not have to turn the tube end for end. After heating, it is cut to length and the end is expanded on the machine *F*; when finished it is placed on the pile marked "finished tubes." This pile, or rack, is on a flue car, and when the set is complete, the car is pushed back, either to the erecting shop or to the storage track.

In this layout, two thoughts have been kept in mind. First, to keep clear of the through track in the heavy machine-tool bay, which it is very desirable to keep free and clear from end to end of the shop; and second, the tube manipulations are not dependant upon the crane service in the heavy machine-tool bay, and therefore are not affected by any delays incident to the crane being in use when it may be greatly desired for lifting and handling tubes. Yet it is possible to use this crane as an

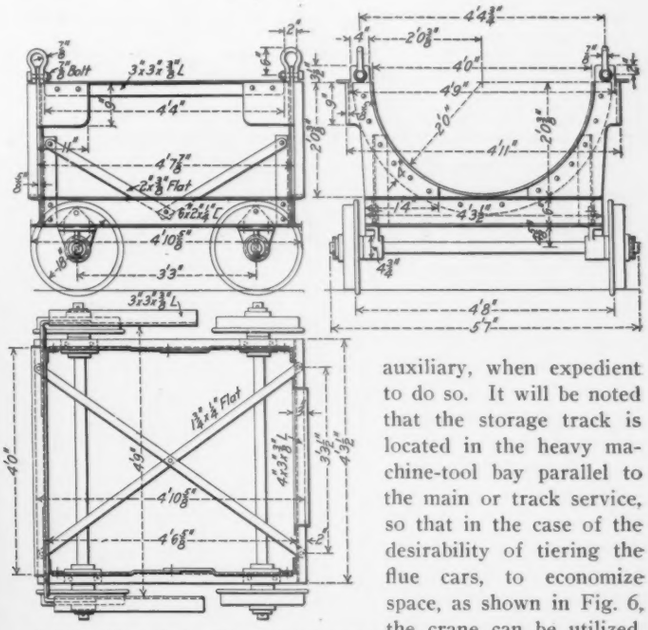


Fig. 5—Details of a Flue Car Arranged for Tiering; Canadian Pacific.

auxiliary, when expedient to do so. It will be noted that the storage track is located in the heavy machine-tool bay parallel to the main or track service, so that in the case of the desirability of tiering the flue cars, to economize space, as shown in Fig. 6, the crane can be utilized, but it is obvious that dependance on the crane for the simple purpose of storage manipulation will not entail any delay in the tube operations.

The overhead type of flue cleaner mentioned above is shown in Fig. 3. The capacity of this machine is 500 2-in. tubes up to 24 ft. long. This machine raises and lowers the tubes in the

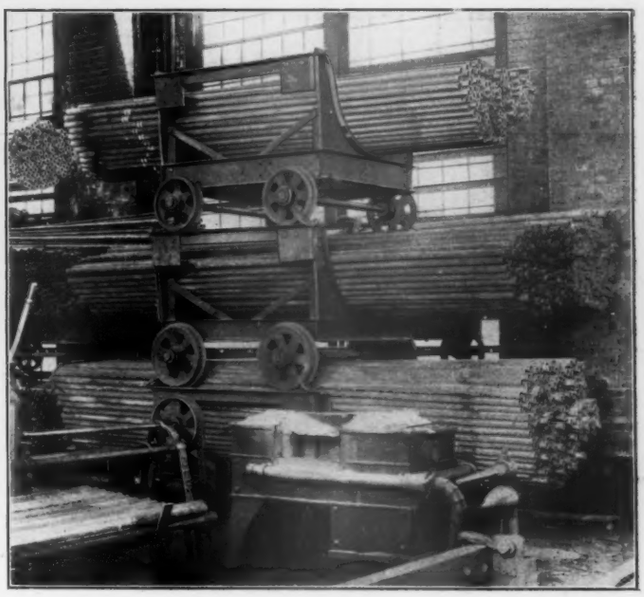


Fig. 6—Method of Tiering Flue Cars on Storage Tracks, Each Car Holds One Complete Set of Tubes.

pit by its own power and may be loaded and started in less than eight minutes and unloaded in the same length of time. It will clean 500 tubes in the same time that the ordinary tube rattler or tumbler-barrel will take to clean one load of approximately 120 tubes and with much less consumption of power. It consists

of an overhead, structural steel, framework of heavy construction, supported by four columns. Four steel sprocket wheels, provided with suitable driving gear, are mounted on this and wide face, case-hardened driving chains pass over them and under a steel idler pulley, and form two loops or slings of equal length, which extend in the pit beneath the framework and support the tubes. By driving the sprockets, the chains cause the

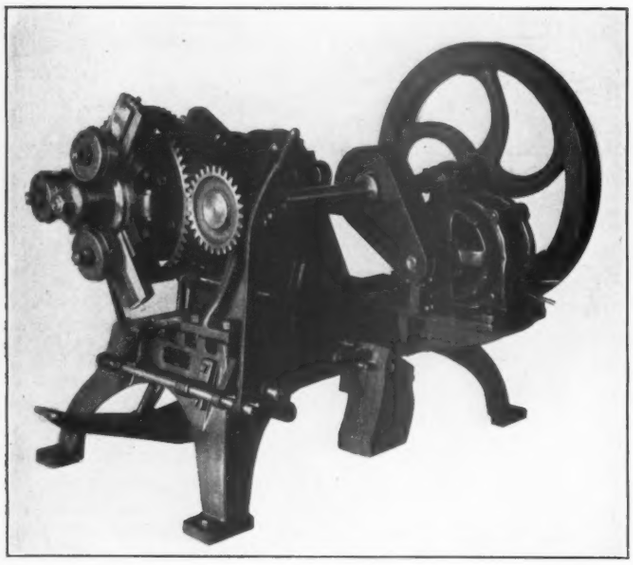


Fig. 7—Hartz Motor Driven Welder with Gear Guard Removed.

tubes to roll over and over on themselves in the cradle formed by the loops. The pair of sprockets carrying the rear chain is mounted on a traverse or bridge, which has a movement to and from the driving end of the machine. The main shaft carrying the sprockets is splined so that by turning the screws, which operate the traverse, the position of the rear sprockets may be changed and the distances between the two slings modified to

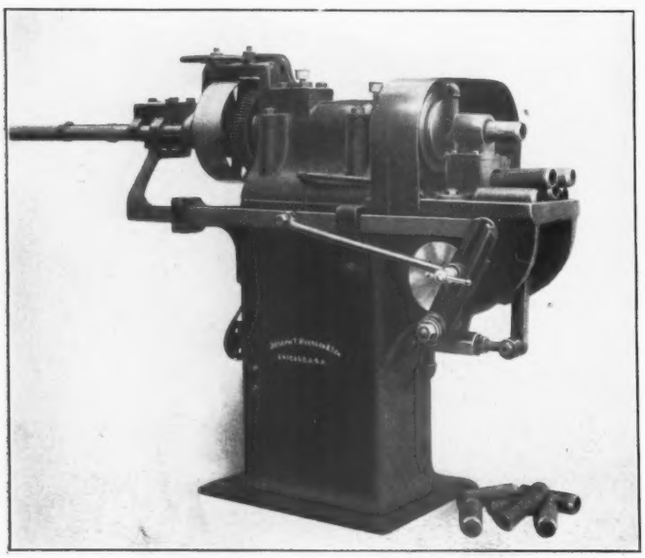


Fig. 8—McGrath Safe End Machine.

suit the length of the tubes being handled. The power of the machine is utilized for changing the position of the traverse carriage.

This machine is also made in another form called pit drive type which has no overhead framework. All the framework necessary for the handling and cleaning of the tubes is integral with the pit itself, and below the floor line of the shop. With this type some form of crane or hoist has to be provided to lift the tubes in and out of the pit. The sling chains used for lifting from the car are loosened and remain around the tubes in a recess provided, while the tubes are being cleaned. The operation of cleaning is performed in the same way as that described for the overhead type and either will clean sufficient tubes to give the output assumed for this ideal shop.

The type of flue car in use at the Angus shops of the Canadian Pacific, which is suited for tiering, one on top of the other for storage purposes, is shown in Figs. 2, 5 and 6. The type of car shown in Fig. 3 is the general form used where it is not deemed necessary to tier the cars.

The form of flue welding machine, selected for this shop, is shown in Fig. 7. The machine is designed to do the complete welding in three operations, and operates on the roller principle. In its latest form it has a range for tubes from 1½ in. to 6½ in.

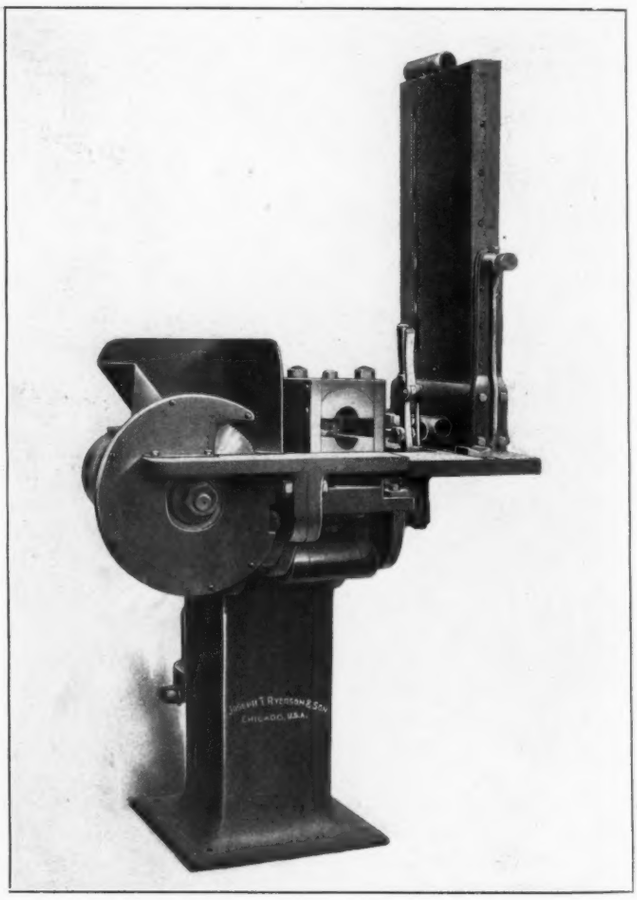


Fig. 9—Hot Saw and Expander with Safe End Magazine.

The adjustment of the rolls is such that a smooth weld, true to gage and practically invisible, is assured. The attachments for the cutting-off, swedging, spreading and scarfing operations can be applied, but owing to the capacity of the machine it is mainly used for welding. In the handling of superheater flues these various attachments may be used to advantage, as the time to change the machine for the different operations is not a serious disadvantage, owing to the small number of flues to be handled a day.

The safe-end cutting-off machine assumed is shown in Fig. 8. This is designed to automatically and correctly cut off to length, scarf and finish safe-ends in any length up to 12 in. and is so arranged that either stock or scrap tubing can be utilized. In general it resembles the ordinary screw machine in that it consists of a substantial base, and means are provided for supporting the tube to be cut. The tube is automatically fed through

a chuck, arranged with proper cutters to perform the operations for any degree of scarf or bevel.

If the customary method of cutting safe-ends on a hollow spindle turret lathe or a pipe machine is followed it will not be possible to attain the price of three cents per tube which the arrangement and apparatus under discussion will give.

A Ryerson combination hot saw and tube expander forms a very vital part of the suggested equipment. This machine (Fig. 9) is arranged to perform three operations; namely, cutting, expanding, and picking up the safe-end. A suitable groove is provided for holding the safe-end, to enable it to be driven on to the end of the tube as described above. There is also a magazine for holding the supply of safe-ends which will automatically permit one to roll in the groove after the one in place has been removed. The saw is supported on a mandrel on the left side of the stand as the operator faces it. It operates at high speed and requires but a fraction of a second to cut off the end of the heated tube. A metal chute is provided for removing the hot fag end. The saw is protected by a hood and is only exposed at the point where the cutting is done. The tube clamping device consists of a lower stationary jaw and an upper jaw mounted on a lever which, in turn, is connected with a pneumatic cylinder. A horizontal cylinder is located directly back of the tube clamp, and the end of the piston rod is provided with a taper mandrel extending between the jaws of the clamp. The operating lever is so connected with the valves controlling the two cylinders that when it is brought forward the clamp jaws close, holding the heated tube in place while the expanding mandrel is forced in the end of the tube.

CAR SHOP KINKS*

BY C. C. LEECH.

TONGS FOR HANDLING CAR AXLES.

The axle tongs shown in Fig. 1 is made from 5/8-in. bar iron forged to the shape shown. The parts that grip the axle are 1¼ in. wide and are so shaped that when they are

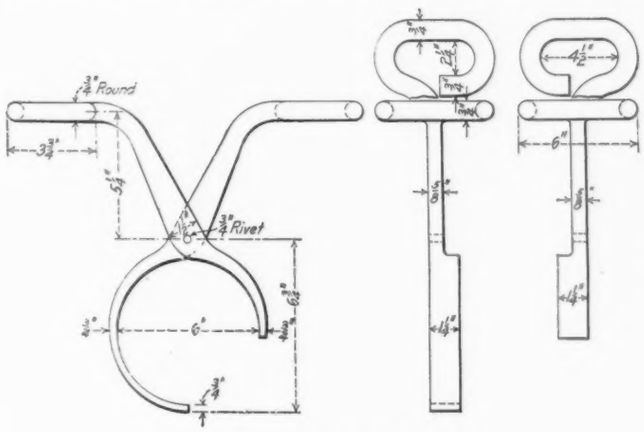


Fig. 1—Tongs for Handling Axles.

in the form of a perfect circle there is an opening of a little less than 90 degs. This insures a positive grip on the axle.

AXLE CENTER FACING JIG.

A burr or rough edge is raised at the center on the ends of nearly all car axles because of the frequent swinging on the lathe center when they are being trued or fitted. This rough edge is objectionable as it sometimes catches the packing in the journal box and displaces it, oftentimes causing the axle to run hot. It is not convenient to change the tools in the axle lathe and move the tool post and carriage around to enable this burr to be faced off, so the jig shown in Figs. 2, 3 and 4 was made to do this quickly by hand, either before or after the axle is mounted.

Fig. 2 shows the device clamped to the axle. It consists of

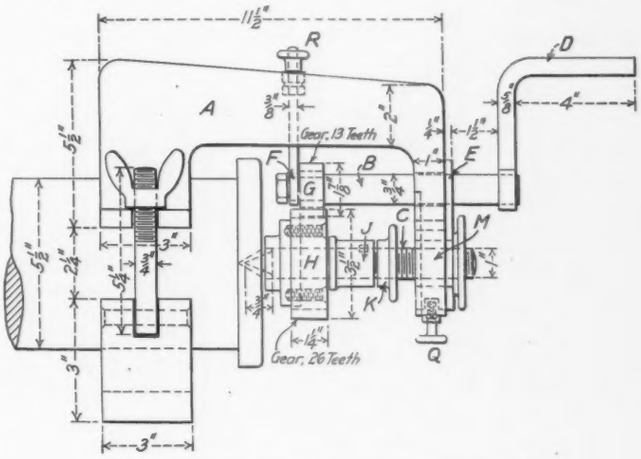


Fig. 2—Machine for Facing Axle Center Holes.

the frame *A*, the driving shaft *B* and the spindle *C*. The frame is rigidly clamped to the axle, as shown in Fig. 3. The driving shaft *B* is turned by the handle *D* and runs in the

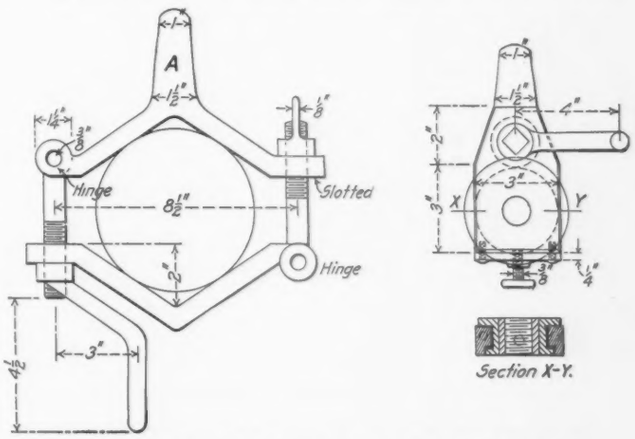


Fig. 3—Clamp and End View of Axle Center Facing Jig.

bearings *E* and *F*. The spindle *C* is driven by the gear *G*, which meshes with the gear *H*. The latter has a broad face and slides freely on the spindle. An end milling cutter is fastened on

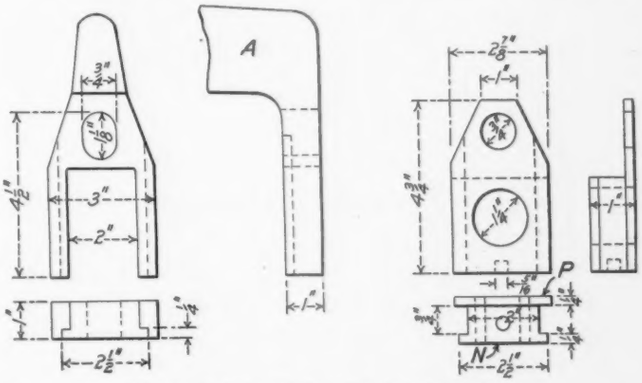


Fig. 4—Details of Spindle Support Block.

the end of this gear, being held to it by screws. The spindle *C* is threaded back of the bushing *J*, and through the nuts *K* and *M*; it is held into the axle center by nut *M*. The nut *K*

*These kinks are taken from Mr. Leech's contribution to the *Railway Age Gazette* September 15, 1911, shop kink competition.

forces the bushing *J* against the gear, pushing the milling cutter against the axle, and thus faces off the burr.

The end of the frame *A* is shown in Fig. 4. It is forked to receive the block *N*, which may be adjusted up or down by the screw *Q* (Fig. 2). It will be noticed that the hole in *A* through which the shaft *B* passes is elongated to allow for this adjustment. The other end of the spindle is adjusted by the arrangement at *R*.

GAGE FOR WHEEL FIT AND JOURNAL LIMITS.

The gage shown in Fig. 5 is made of steel and is used for measuring the diameter of the car journals. It consists of the part *A* and the sliding part *B*, which has a set screw and key for locking it fast at any of the lines *C*. A pin *D* keeps the

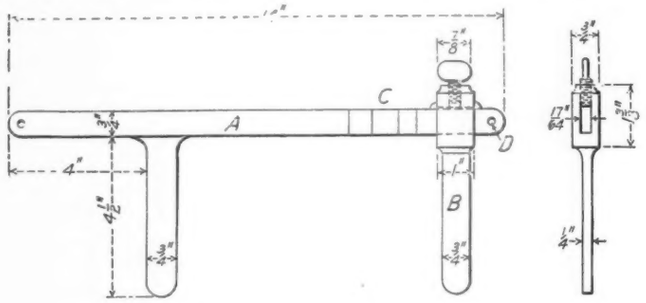


Fig. 5—Gage for Axle Diameter Limits.

part *B* from slipping off the end. The extension of part *A* at the left serves as a handle. When an axle is dismounted at the wheel press it can be quickly ascertained whether it is below the prescribed limits by trying the gage which has been set to the limit line for the axle which is to be inspected.

WHEEL BORING MILL ATTACHMENT.

Nearly all the flanges of cast iron car wheels are more or less warped, and in order to make a pair of wheels tram properly the high sides of the flanges should be diagonally opposite when the wheels are pressed on the axle. To find this spot quickly and accurately the attachment shown in Fig. 6 was made. The parts are of forged iron and may be made to suit the boring mill. The bracket *A* is bolted to the column of the machine and carries the arm *B*, which is free

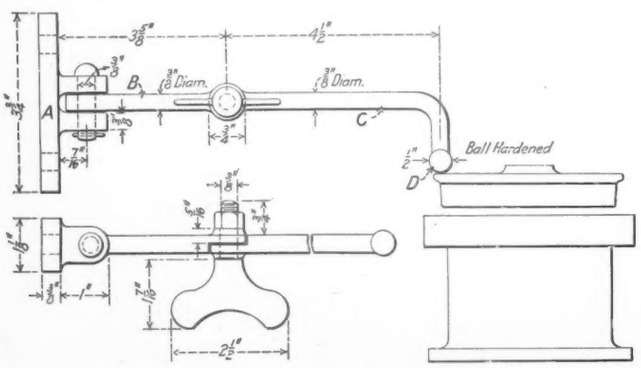


Fig. 6—Device for Testing Warped Car Wheels.

to move in a horizontal direction. The arm *C*, which moves in a vertical direction, is secured to this by a thumb screw and nut. After the boring mill is started the operator pushes down the arm *C* until the hardened ball *D* just touches the highest point on the wheel flange. He marks it with chalk, also noting the amount that the flange runs out. He is then able to pair the wheels that run out about the same amount and mount them to correct the defect. He is also able to quickly detect any wheels that should be condemned. The two movements of the arm prevent the ball end from being caught on a rough spot and being bent.

ADJUSTABLE FLANGE GAGE FOR CAR WHEELS.

When new or old cast iron or steel wheels are paired for mounting, it is desirable and necessary to have very little variation in the flange thickness, in order that the wheels after being mounted on the axle will run properly over the rails and frogs. The adjustable gage shown in Fig. 7 is made of hardened tool steel. The part *B* slides freely on part *A* and allows the gaging joint *E* to go up against the outside of the wheel flange, the gage fitting down over the flange, part *D* being on the in-

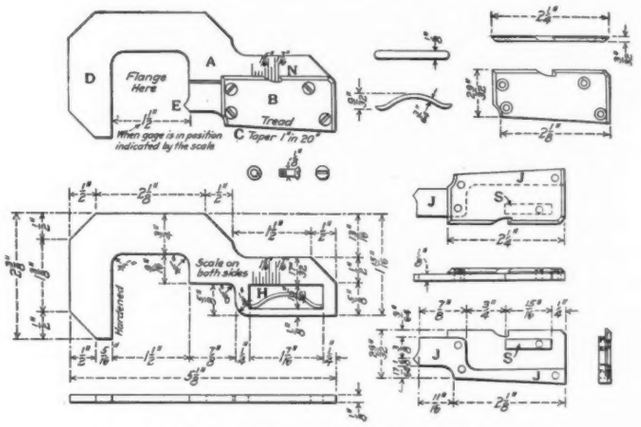


Fig. 7—Gage for Measuring Flange Thickness.

side. The index point at *N* shows the thickness of the flange as indicated by the scale, which is stamped on both sides of the part *A*. The lower edge of *B* is made the same taper as the wheel tread and rests on it when the flange is measured. Detail parts are shown in the illustration. The piece *B* has a small strip *S* riveted to it, which acts as a stop. The small spring *H* which is located in *A* also bears on *S* and holds the part *B* firmly to *A*. On the lower side of *B* is fastened the part *J* which has the gaging point *E*.

HOOKS FOR LIFTING CAR WHEELS.

The device shown in Fig. 8 is used to lift car wheels to the table of a boring mill. Its design is clearly shown in the illustration. There are two adjustable arms having U-shaped ends which are bent so as to hook over the flange of the car wheel.

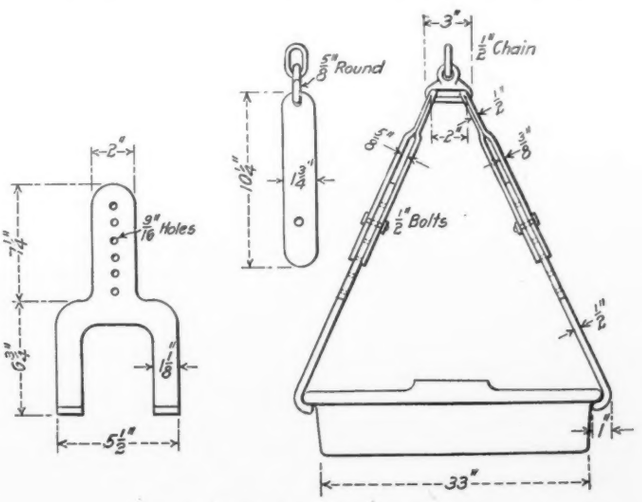


Fig. 8—Hooks for Lifting Car Wheels.

The U-shaped pieces fit in the upper part of the arm, as shown, and adjustment is provided by the six holes. The upper end of the arm is held in a clevis which has a ring for the hoisting hook. The adjustment allows for handling of wheels of varying diameters.

TIRE GAGE.

A tire gage is shown in Fig. 9. It is made of tool steel ¼ in. thick, and consists of the body *A*, which is in one piece with the part *D*, and the movable arm which slides up and down on *D*, and is held in position by the screw and key *E*. A slot is cut in the arm to allow the crosshead *B* to be moved over the lowest joint in the tire tread. The gaging screw *C* is then set down till it bears on the tread of the tire. The amount that the screw extends below the arm is subtracted from the distance

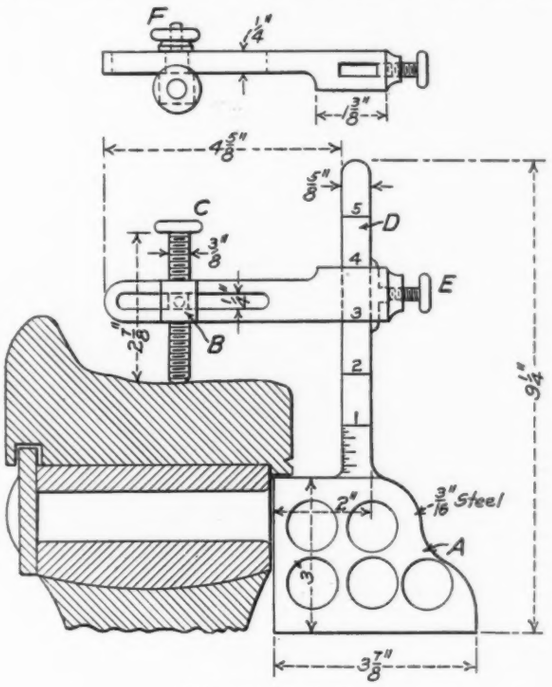


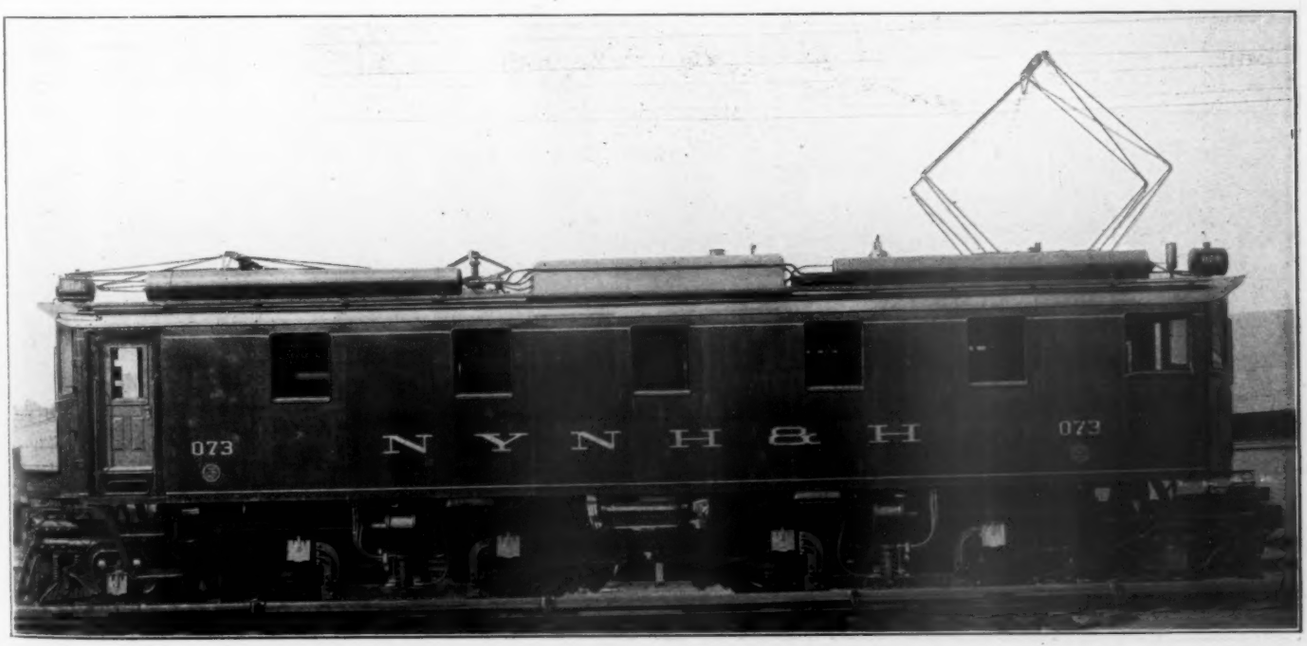
Fig. 9—Tire Gage.

that the arm is from the zero line, which in this case is 3 in., to give the tire thickness. Care must be exercised to allow for the shoulder on the tire. The method of applying the gage is shown on the sketch. The part *D* is graduated its full length, as shown on the first inch. One turn of the screw *C* raises or lowers the screw 1/16 in. In order to get a square bearing for the gage against the wheel rim care should be exercised to clean off the paint, so that there are no lumps. Holes are drilled through *A* to lighten the gage.

ARTICULATED ELECTRIC LOCOMOTIVES WITH EIGHT MOTORS

In each order of electric locomotives built for the New York, New Haven & Hartford during the past two or three years, there have been incorporated new features of design, but in the thirty-nine heavy service locomotives now under construction by the Baldwin-Westinghouse companies no new features have been introduced, but all the arrangements that have proved to be best in everyday road service of the previous locomotives have been combined. The most noticeable feature is one that was applied experimentally to a single locomotive over a year ago and consists of the use of eight motors for four pairs of drivers. These are arranged in four units of two motors, each pair having practically one casing and both driving on the same quill. The articulated type of running gear, consisting of two trucks, each having two pairs of drivers and a pony truck, connected by a drawbar at the center and so arranged that no forces are transmitted through the cab underframe, has again been used.

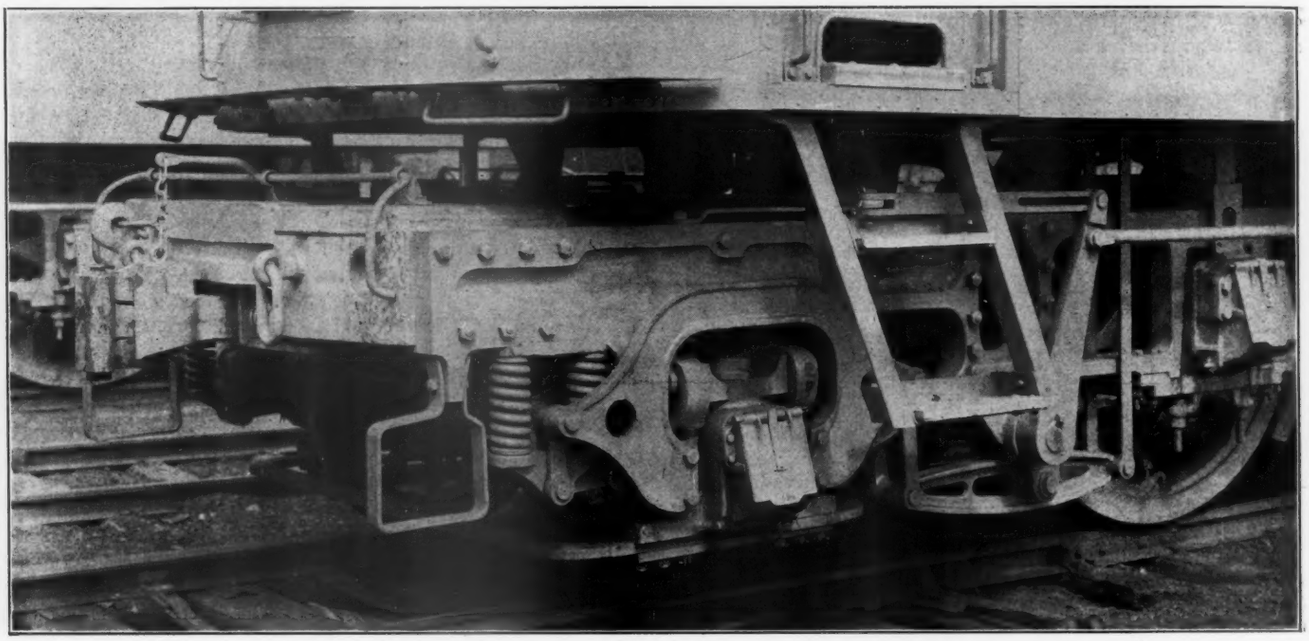
Experience has shown that the eight-motor arrangement is a desirable one for the following reasons: Peripheral speed is a limiting feature in railway motor design and with two small motors it is possible to use a rotative speed approximately twice that of an equivalent large motor. Each motor thus has about one-half the number of poles of practically the same size required by an equivalent large motor. Therefore there is no increase in the number of parts, such as field coils, armature coils, brush holders, etc, in the two small motors over what would be required for an equivalent large motor. Furthermore, there is considerable saving in weight and space due not only to each of the motors being one-half as large in diameter, but also because each motor exerts about one-half the torque and a single gear can be used on the quill in place of the two gears previously found necessary. This allows the motor to be made longer and in a more economical design. The motor armatures used on these locomotives are interchangeable with those used on the other motor cars of the New York, New



Eight-Motor Type of Electric Passenger Locomotive for the New York, New Haven & Hartford.

Haven & Hartford and the New York, Westchester & Boston. Outside of the twin motor application, these electric locomotives are very similar to those built by the same companies for the Boston & Maine for use in the Hoosac tunnel.* Each pair of motors is bolted to the truck frame over each pair of driving axles and as part of the bottom of their casing there are two axle bearings which carry a quill concentric with and surrounding the axles. The inner diameter of the quill is three inches larger than the diameter of the axles. A single gear is secured to one end of the quill and the two pinions keyed to the ends of the armature shafts mesh with it. The connection between the quills and the driving wheels is effected through helical springs mounted between the driver spokes and projecting arms provided on each end of the quill. In this way the dead weight of the motors and quill are carried by springs and the wheels have sufficient clearance and freedom to follow irregularities in the track.

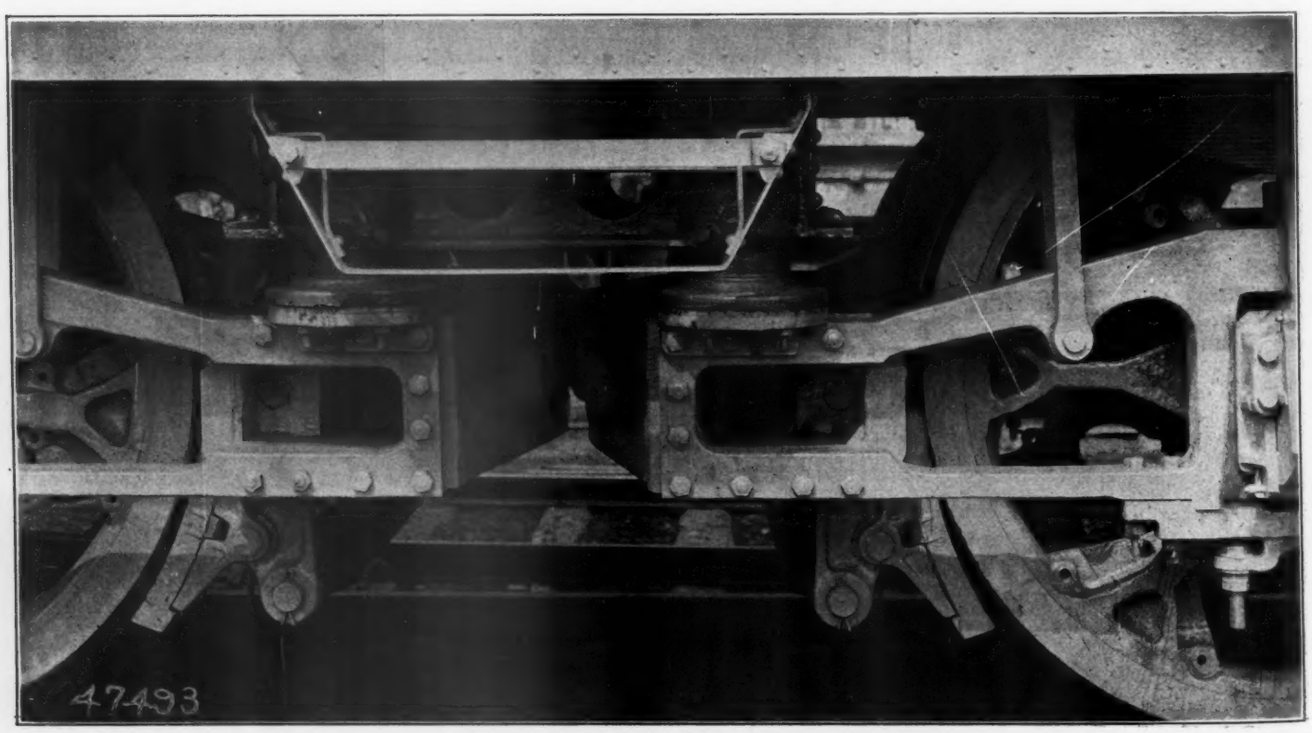
Each motor has a capacity of 170 horsepower, hourly rating,



Construction of Electric Locomotive Trucks at the Outer End.

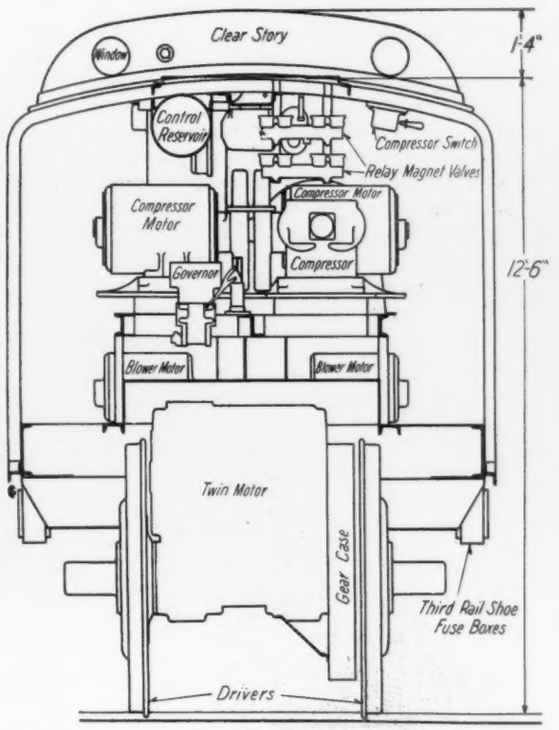
and three of the locomotives are arranged for operation on either alternating or direct current, while the remaining thirty-six are for alternating current only. Each pair of motors is connected permanently in series, and when the locomotive is operating with alternating current the four pairs are connected in multiple. When direct current is being used, however, ar-

*See *American Engineer and Railroad Journal*, November, 1911, page 446.



Articulated Connection and Cab Supports of Electric Locomotive.

rangements are made so that two pairs can be connected in series as well. The construction is suited for 11,000 volt, 25 cycle, single phase, alternating current, or 650 volts direct current. The locomotives arranged for alternating current only are intended primarily for fast freight service, and are designed to handle a train of 1,500 tons at 35 miles per hour. They are

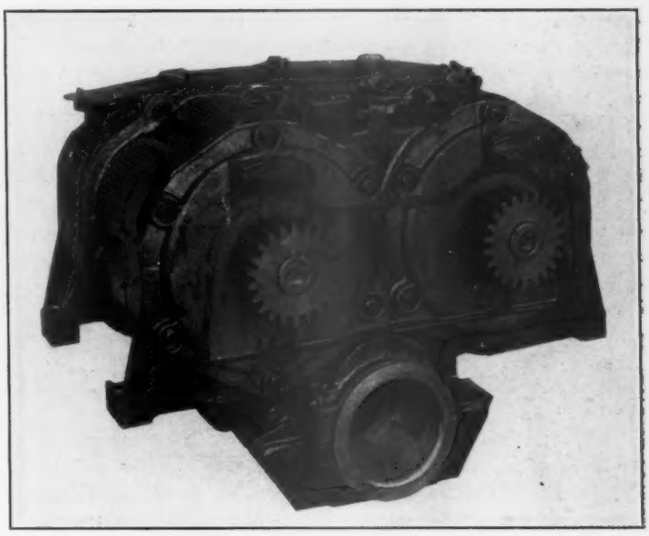


Transverse Section of Twin Motor Type of Electric Locomotive.

expected to deliver a maximum tractive effort of 40,000 lbs. The remaining three are for fast freight and heavy passenger service, and are designed to handle a trailing load of 800 tons at a maximum speed of 45 miles an hour.

Each group of two pairs of drivers and pony truck has cast steel frames of the bar type equipped with regulation shoes and wedges. These are located outside the drivers and are connected by heavy steel castings at either end, and a built up steel structure acting as a center plate support and frame brace is secured across the frames between the drivers. The tractive effort is transmitted from truck to truck by means of a drawbar arranged to leave a half-inch maximum clearance between the bumper plates of the trucks when all the slack is taken up. Spring buffers are provided at this point, and the drawbar has a slotted hole in one end so that all buffing shocks are taken directly by the buffer and the drawbar is never placed in compression.

A radial type drawbar arranged to receive a housing for a Westinghouse friction gear is mounted on either end of each truck. This is provided with a centering device. The pony trucks are of the Rushton type, with outside journals. The

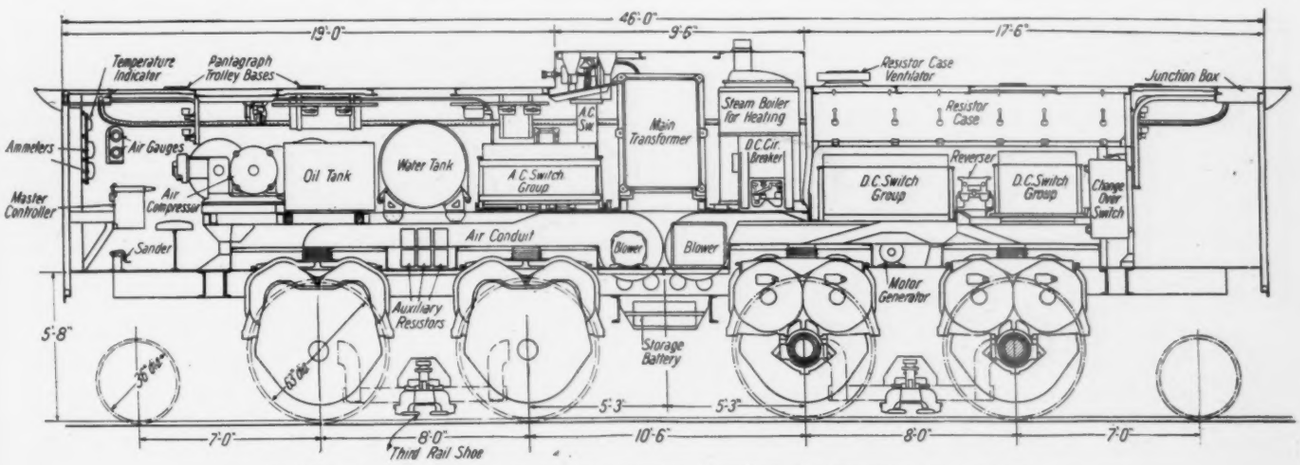


View of Pinion End of the Twin Motor Units.

equalization scheme provides a four point support for the whole locomotive.

The cab underframe is composed of two 12-in. channel side sills and two trussed center sills. It covers the whole locomotive, and the cab is built of steel plate on a Z-bar frame. The cab is supported at four points on each truck, the two at the center being 84 in. apart transversely, while the two at the ends are about 34 in. apart. The weight of the cab and the equipment carried is transferred to the truck through coil springs and the spring pocket plungers are allowed to slide on the bearing secured to the truck frame. This construction is clearly shown in the view of the articulated connection. The center pins carry no weight, and are employed simply to hold the cab in its position. One of them is allowed sufficient longitudinal movement to prevent any of the pulling or buffing stresses from passing through the cab underframe.

When operating on alternating current, the energy passes through an oil circuit breaker, through the primary of the main



Section of A. C.—D. C. Locomotive Showing Location of Apparatus in the Cab.

transformer and then to the ground. A number of taps, provided on the secondary winding of the main transformer, are connected through preventive coils, by means of pneumatically operated switches, to the motor circuits. There are twelve voltage steps on the transformer, of which nine are for running points. The pneumatically operated switches are assembled in one group located close to the transformer. The reversal of the direction of rotation of the motors is effected by two pneumatically operated drum type reversers, each of which is so connected as to control two pairs of motors. There are two blowers located in the center of the cab directly under the main transformer. These are each driven by an a.c.-d.c. motor, and draw the air from the outside of the locomotive, discharging it through the main transformer, motors and resistors. There are two motor-driven air compressors, each having a capacity of 50 cu. ft. of free air per minute, provided for the operation of the air brake and control equipment. An oil burning steam heater plant capable of supplying 800 lbs. of steam per hour is installed on the passenger locomotives.

The thirty-six alternating current locomotives have the following general dimensions:

Length between coupler faces	50 ft.
Maximum width	10 ft. 3 in.
Maximum height over cab	13 ft. 10 in.
Rigid wheel base	8 ft.
Total wheel base	40 ft. 6 in.
Driving wheel diameter	63 ft.
Driving journals	7 x 13 in.
Truck wheels diameter	36 in.
Truck journals	6 x 12 in.
Weight on driving wheels (a.c.-d.c. locomotive)	182,000 lbs.
Weight, total (a.c.-d.c. locomotive)	240,000 lbs.

CUTTING SPEED ON PLANERS.

A method of obtaining an equivalent planer speed to cover any combination of cutting and return speeds, and give the average for the full cycle, has been developed by L. R. Pomeroy, consulting engineer, New York. This will be found useful in connection with detailed studies of machine tool operation, particularly time studies.

Let C = cutting speed in feet per min.
R = return speed in feet per min.
E = equivalent cutting speed in feet per min.

$$E = C \div 1 + \frac{C}{R}$$
$$= \frac{C \times R}{C + R}$$

For example, if C = 40 ft. per min., and R = 100 ft. per min.

$$E = \frac{40 \times 100}{40 + 100} = 28.6 \text{ ft. per min.}$$

If the work is 12 in. wide and 10 ft. long and a feed of ⅛ in. can be taken, the time for cutting will be

$$\frac{8 \times 12 \times 10}{28.6} = 33.6 \text{ min.}$$

the equation being

$$\frac{(\text{Cuts per in.}) \times (\text{width in inches}) \times (\text{length in feet}) \times (C + R)}{C \times R}$$

Overrun can be included as a percentage of the length of cut.

By using the ratio of the cutting to the return speed the equivalent cutting speed is obtained even more simply.

Ratio 1 to 1	E equals ½ C
Ratio 1 to 2	E equals ⅔ C
Ratio 1 to 3	E equals ¾ C
Ratio 1 to 4	E equals ⅘ C
Ratio 1 to 5	E equals ⅚ C

Ore Traffic.—The Bessemer & Lake Erie in the month of May hauled from Lake Erie to the mills of the Pittsburgh district 23,584 cars of ore—1,115,000 tons. This is 62,000 tons more than was ever before carried over the line in a single month.

LOCOMOTIVE BOILER LOW WATER TESTS

As a culmination of the extensive series of comparative locomotive boiler tests that have been under way at Coatesville, Pa., during the past five months, the two boilers were subjected to a trial for determining the effect of low water. This test took place on June 20 at Coatesville and resulted in the giving way of the crown sheet of the radial stay boiler when the water had fallen 14¼ in. below the crown sheet level, while the Jacobs-Shupert boiler gave no signs of failure or distress after 55 minutes and when the water level was more than 25 in. below the top of the crown sheet. The impossibility of obtaining sufficient steam from the water remaining in the boiler to maintain a pressure of more than 50 pounds and give the required draft, forced the closing of the test.

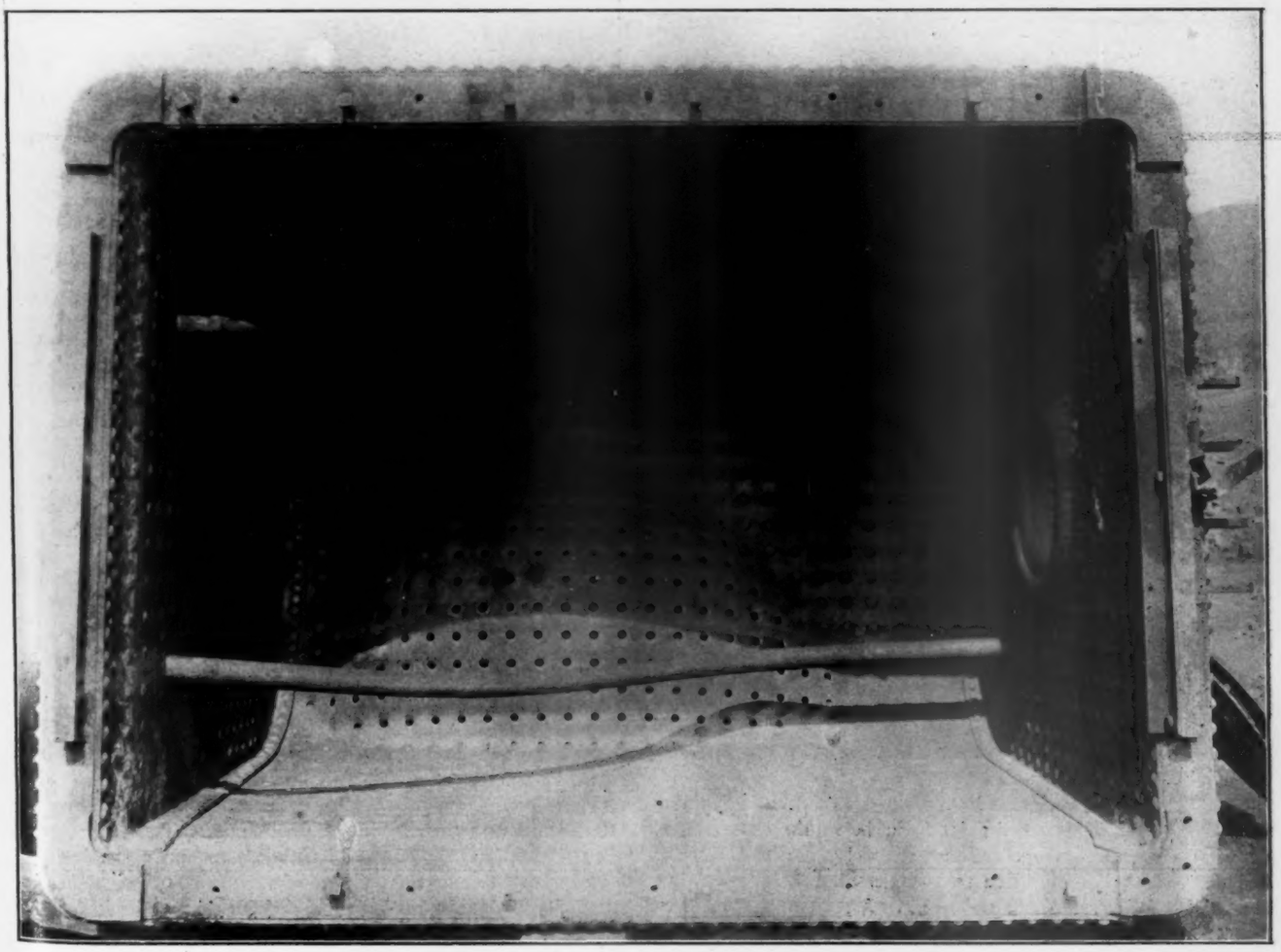
These tests were outlined by and have been conducted under

Radial Stay Boiler Just as the Crown Sheet Gave Away.

the direction of Dr. W. F. M. Goss, and have very fully covered the comparative results for efficiency, capacity, water circulation and strength of the two boilers, which were identical in construction with the exception that one was fitted with a Jacobs-Shupert firebox, while the other had a normal radial stay firebox.

In preparation for this test, both boilers were placed on the cinder dump of the Lukens Iron & Steel Company, at a point sufficiently far away from houses and other buildings to prevent accident in case of the complete rupture of the boilers. This dump is located in a valley and the adjacent hillside offered a splendid position for the spectators. A grandstand was built about 2,500 ft. from the nearest boiler and here the invited guests had an excellent view of the proceedings. A bomb-proof consisting of a firebox turned on its side was located about 250

Radial Stay Boiler After the Low Water Test.



Interior of the Radial Stay Firebox After the Low Water Test.

ft. from the boilers, and from this point the oil fuel, feed water pump and draft were controlled. Here also were mounted telescopes through which the reading of the steam gage and the water level gages were made. Telephonic communication between the bomb proof and the grandstand was arranged and an announcer at the latter point gave continuous information on the progress of the test. In addition, a large water level and steam pressure indicator mounted near the bomb proof showed the height of the water level and the amount of steam pressure in the boilers at all times.

The Jacobs-Shupert boiler was tested first. At the beginning of the test the water level stood 6 in. above the crown sheet and the steam pressure was 225 lbs. The feed water supply was then shut off and part of the steam generated was used for draft, the remainder being blown out through the three large pop valves set to close, one at 225 lbs. and the others slightly higher. The water level continued to fall and at the end of ten minutes the top of the crown sheet was bare. The steam pressure remained at about 225 lbs. The water level began to fall quite rapidly and after it had reached a point about 10 in. below the crown sheet, it was evident from the appearance of the steam emerging from the pop valves that superheating was taking place. Gradually one safety valve after another seated and when the level had reached a point about 18 or 20 in. below the crown sheet, the steam pressure fell enough to permit all

Back End of the Jacobs-Shupert Firebox After the Test.

the safety valves to close. It continued to fall quite rapidly until the level had reached a point 25 in. below the crown sheet, which was the limit to which the water level gages read, when it had dropped to 190 lbs. The test was continued, however, but the rapidly falling pressure reduced the blast and the combustion became more and more incomplete. This was clearly indicated by the large amount of black smoke pouring from the stack. Finally, when the pressure had dropped to 50 lbs., about 55 minutes after the test began, it was necessary to discontinue it for lack of steam pressure, due to the small amount of water remaining in the boiler. Reference to the illustrations will show the condition of the firebox at the completion of the test and it will be seen that there is no visible distortion of the plates, although it is very evident that they were highly heated. The

Interior of the Jacobs-Shupert Firebox After the Low Water Test.

brick arch tubes were in no way disturbed nor do they show any signs of leakage, although practically half their length was above the water level at the end of the test.

While the test of the Jacobs-Shupert boiler was going on, the radial stay boiler was being prepared and the test on it was immediately started. It was subjected to exactly the same conditions and, after an interval of about 10 minutes, it was announced that the crown sheet was bare. The pressure at this time was from 225 to 230 lbs. When the water level had reached a point about 6 in. below the crown sheet some leakage appeared around the staybolts in the outer sheet, and the joint between the throat sheet and shell developed a leak. These, however, were all comparatively small. The pressure was maintained and the water level continued to fall until it had reached a point 14¼ in. below the crown sheet, which occurred about 23 minutes after the test had begun, when an explosion took place which lifted the boiler and threw a shower of brick, piping, timbers, etc., over a space of about 50 ft. in every direction. The boiler was displaced from its foundation and thrown about 18 in. to one side as is shown in one of the illustrations. Examination showed that the crown sheet had given way in a sag but that it had not split or cracked. It was found that 72 hammer headed stay bolts, 81 button headed stays and 21 T-bar bolts had pulled out. The damage was largely on the right side, beginning at about the second row of T-bars and extending back 14 rows.

REPAIRING DRIVING BOXES*

BY M. H. WESTBROOK.

The writer has noted over 50 different variations of the necessary 10 or 12 operations for completing each driving box of a locomotive, and gives below what is judged to be the best methods so far observed. As there are necessarily a far greater number of boxes repaired than new ones made, the discussion

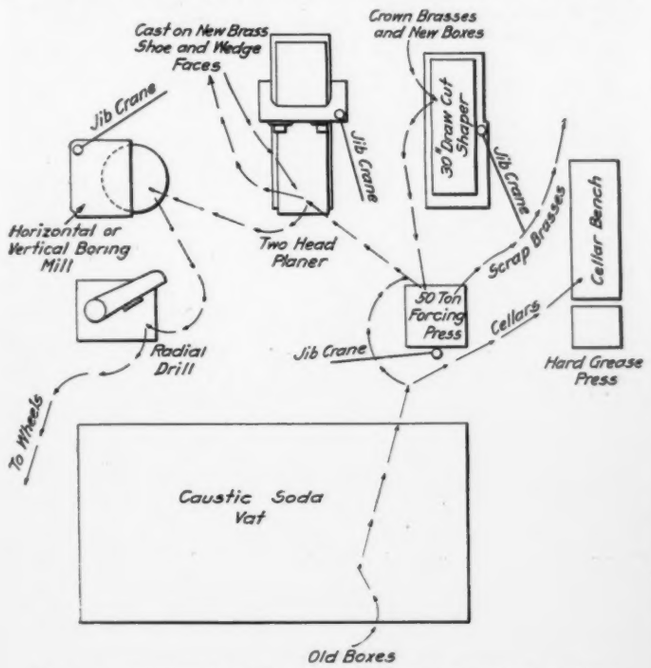


Fig. 1—Arrangement of Tools in Driving Box Section of Shop.

is largely confined to the repairing operations, with only an occasional reference to new boxes.

The size and character of the shop and the nature of its equipment must, to a large degree, enter into the method of doing this class of work, and will also be a factor in deciding

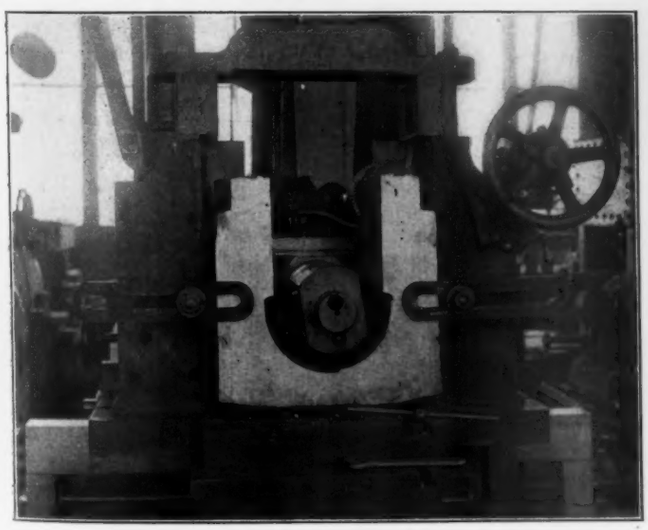


Fig. 2—Machining the Crown of New Boxes on a Draw Cut Shaper.

whether certain machinery should be installed or not. The methods described are suited for a shop operating 15 or more pits, and the arrangement of tools in Fig. 1 is suggested as the best to get the most efficient results.

Facing New Boxes.—This operation should be performed on a heavy double-head planer, setting the boxes up in two rows. This method is preferable to milling, because steel boxes are frequently so full of sand, that the work is very destructive to the milling cutters, which are not as easily made or resharpened as planer tools. The castings should not have more metal left on them than can be removed in one cut, and ordinarily this operation on a set of six steel boxes should be completed in less than four hours.

Machining the Crown of New Boxes.—An excellent method of machining the crown of new boxes is by using a Morton draw-cut locomotive shaper, as shown in Fig. 2. This process ordinarily takes about one hour per box (12 in. brass) after the fixture is set up. The usual way of doing the work on a slotter will require a considerably longer time.

Machining the Brass.—What is believed to be the quickest and most economical method of machining the crown brass is shown in Fig. 3. This is on the same machine as shown in Fig. 2. The brasses are cast to the proper length and should require no machining on the ends, although this is being done in many shops. The time taken for machining the brass ready

Fig. 3—Finishing a Crown Brass on a Draw Cut Shaper.

to press in the box is 45 minutes for an average every-day performance.

Pressing in the Brass.—The method of pressing the crown brass in the box, using a Lucas 50-ton forcing press is shown in Fig. 4. New brasses are forced in new boxes in a very few minutes at a pressure of about 25 tons.

The practice recommended when forcing the brasses in old boxes is as follows: A standard cellar for each class of box should be kept at the press and used as a gage so that in forcing in the brass the proper pressure will be used to spring the legs back to their original position. This practically brings the shoe and wedge faces parallel to each other, and permits the minimum amount of planing. It also insures the cellars being maintained to a standard size. Instances have been observed where brasses were pressed or cast in regardless of this feature, and either the cellars were refitted to suit, or the boxes were machined to fit the cellars. In some cases the whole set would have cellars of different sizes.

In taking data from 500 boxes it was found that to press in the brass and spring the box back to its original shape, the

*Entered in the shop practice competition which closed May 1, 1912.

pressures ranged from 17 to 28 tons. Using these pressures has resulted in no trouble whatever, owing to variation of pressure fits. The operator on the shaper soon becomes expert in making the proper allowance for springing the legs back, if he calipers the box first to ascertain the amount the legs have closed in at the points. The operation of pressing in the brass to meet these requirements averages 25 minutes. Only occasionally do they

Fig. 4—Pressing in the Brass.

have to be removed and filed before pressing all the way down.

Some roads make a practice of pouring in the crown brasses, and the writer will leave the advocates of that method to speak for themselves. It has been praised highly by some and condemned by others as unsatisfactory.

Shoe and Wedge Channels.—Some shops are using a brass liner fitted in and covering the whole channel, which has to be machined on its three outside surfaces and also on six end

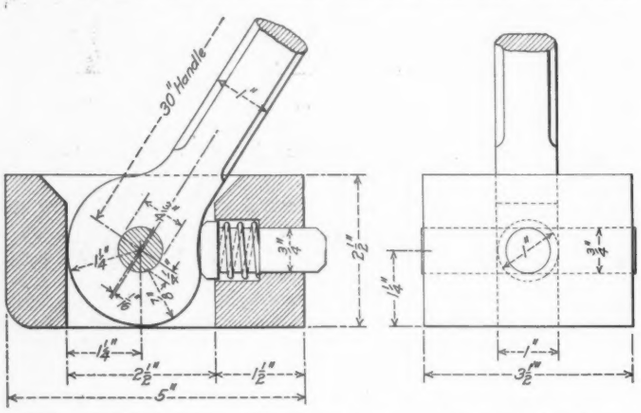


Fig. 5—Holder-On for Rivets in the Flanges of a Driving Box.

thrust strips. After the liners are fitted to the previously machined surfaces in the box they are drilled and riveted on the sides and fastened by six or more countersunk bolts. This method seems to be altogether too involved and expensive and takes up an unnecessary amount of time. When this or a similar practice requiring riveting on the flanges is standard, Fig. 5 shows a holder-on for the rivets that will be found to be very convenient.

There is little question but that the practice of having the shoe and wedge faces of the box lined with brass is highly commendable, especially on the heavier classes of locomotives. While it adds but slightly to the cost of the driving box work, it enables the engine house forces to keep the wedges adjusted much better than where the steel faces are wearing against cast iron shoe and wedge surfaces. The heavy pull on these faces

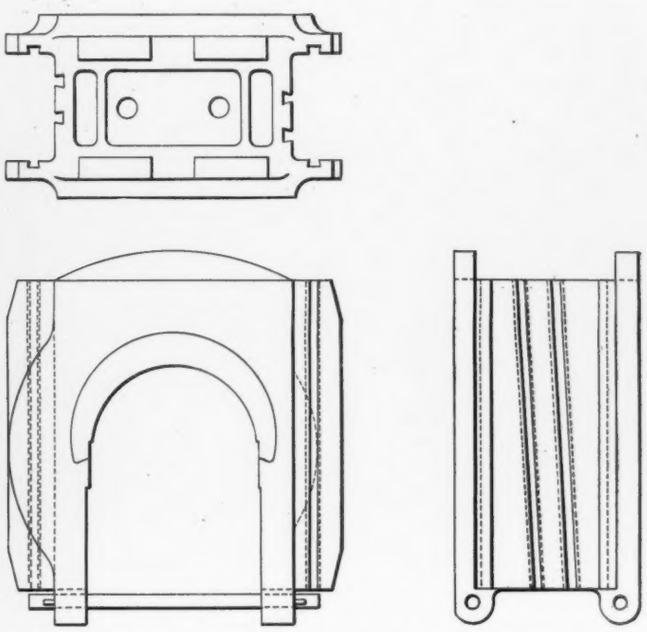


Fig. 6—Driving Box Prepared for Pouring Brass Liners in Shoe and Wedge Channels.

where brass is not used and the continual vertical movement caused by running over rough roadbeds, cause a bad scoring on both the box and shoe and wedge faces. Cases have been seen where these faces were so badly scored that it was possible to almost lay a little finger in the cavities which had corresponding projections on the opposite face. This, of course, prevents a proper adjustment of the wedges with its consequent effect on the efficiency or length of time in service of the locomotive. On the other hand, engines have come into the shops for repairs with a record of 60,000 or 70,000 miles, having brass

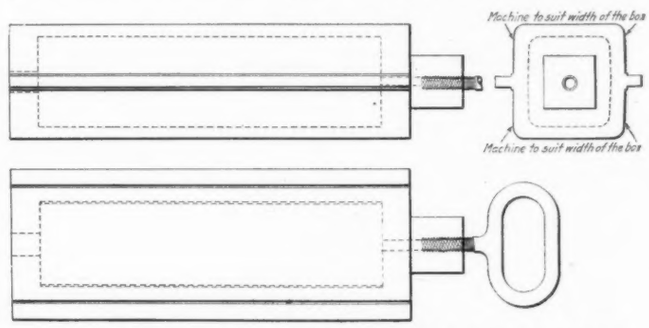


Fig. 7—Cast Iron Forms for Pouring Shoe and Wedge Liners.

faces on the boxes that were perfectly smooth and not worn over 3/64 in. from the time they first went into service.

A method of lining these faces is shown in Fig. 6. Boxes that have previously been fitted with lines, held in place by rivets and screws, should be planed out as shown. Two dovetailed grooves are planed slightly diagonal in the bottom of the channel and experience has also shown that the grooves on the sides prevent the brass from shrinking away while cooling. By doing this it is only necessary to slightly heat the boxes before pouring the lines. The operation of planing out old boxes to

receive the brass requires about one hour per box. Cast iron forms (Fig. 7) are held on the boxes by clamps which are placed on end on a plate for pouring. These forms should be machined as smoothly as possible and be given a slight taper inward. An allowance of 1/16 in. on each face is ample for finishing to size. After the metal is ready, one man and a

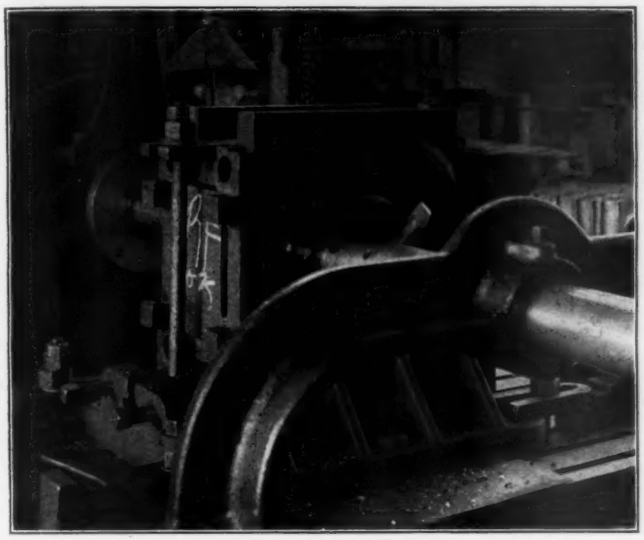


Fig. 8—Boring the Brass on the Jig Shown in Fig. 9.

helper can pour a set of six of the largest boxes and have them all ready for the planer in less than one hour. This is less time than one slipper could be fitted to a box. There seems to be no good reason for the brass extending up the sides of the channel, and in repairing boxes that have not already had shoes extending up the sides, it seems best to pour the brass on the

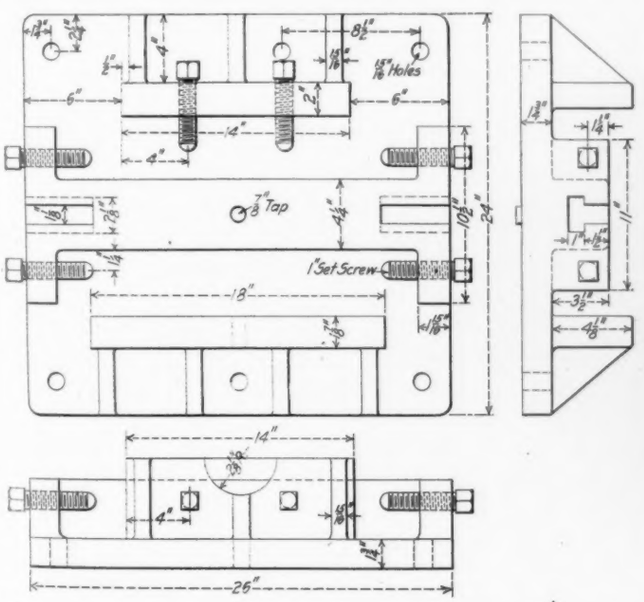


Fig. 9—Jig Used on Horizontal Boring Machine When Boring the Crown Brass.

shoe and wedge faces only, the box of course first having the two dovetailed grooves planed in the faces.

Boring the Brass.—A good method of boring, using the jig in Fig. 9, is shown in Fig. 8. Two tools are arranged so that as soon as one leaves the brass the other starts to cut, enabling the box to be bored in one setting in most cases. The boxes are planed central and the shoe face always rests on the jig, thus ensuring every box being bored alike; only the first one needs to be laid off. There is not much to offer in support of this being a better method than machining on a vertical boring mill. The time occupied by either machine is about the same, from 20 to 40 minutes, depending on whether the cellar is to be bored out at the same time or not.

Hub Liners.—Where brass or babbitt hub faces are used on the driving wheels, very little lateral wear takes place on the driving box. It seems to the writer, after a period of obser-

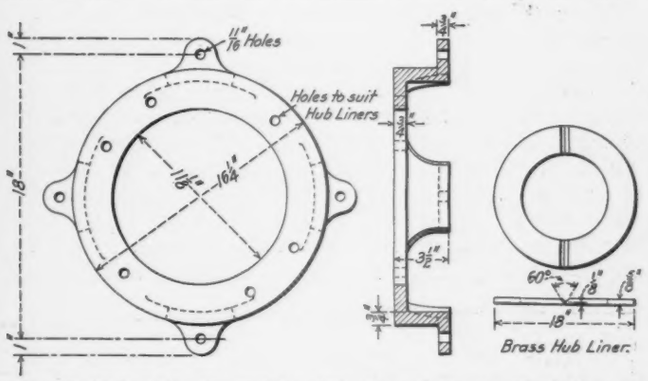


Fig. 10—Hub Liner for Driving Wheels and Jig for Machining It.

vation exceeding eight years, to be much better to face the wheels instead of the driving boxes. Two methods of taking up the lateral wear are given below as being the best in the judgment of the author.

Fig. 10 shows a brass hub liner and a jig for machining it. The liner is cast with the weakening groove as shown, and after being faced and turned to the required measurements, is broken in two halves by being thrown on a block of wood. These halves are then clamped on the wheel and the holes drilled in the wheel face to correspond with the countersunk holes already drilled in the hub liner and used to hold it while being faced on the jig. The holes on the wheel are drilled slightly larger at the bottom by a wobble drill, and copper or brass

Fig. 11—Pouring Babbitt Hub Liners.

rivets or plugs are driven into the wheel and riveted over to fill the countersunk holes in the hub liner. This method is much quicker than tapping the holes in the wheels and is quite as effective.

The other method, that seems to the writer to be better, is illustrated in Fig. 11, which shows two boys pouring hard babbitt faces on the wheels, using an adjustable molding jig that can be set for any desired thickness of liner. The boys shown have poured a set of six wheels, including the time for melting the babbitt, in four hours, the proper thickness of the

liner having first been given them. To use this method good hard babbitt must be employed and the wheel center should have a dovetailed counterbore about ½ in. deep cut in it. A heavy locomotive having a mileage of over 100,000 miles shows less than ⅛ in. lateral wear, and the only failures noted with this method have invariably been when a soft or poor quality of babbitt has been used. The writer's experience has been with oil lubrication and the effect of grease on liners of this kind has not been considered.

Fitting the Boxes.—There is much diversity of opinion regarding the fitting of the boxes to the journals. Some shops bore the brass 1/32 in. larger than the journal and put it up in that condition. Others carefully file and scrape the brass to a perfect bearing. All journals that have become worn either out of round, out of center or taper 1/32 in. or more should be turned. They should be tested in the lathe while revolving on their centers, as many journals are found to be perfectly round and parallel with calipers, but when put in the lathe they run considerably out of true. If this is done and the boxes are bored to a good fit for the journals, slightly easing off the sides with a file only, there is no need of scraping or filing to a fit. This operation need not take more than 30 minutes per box.

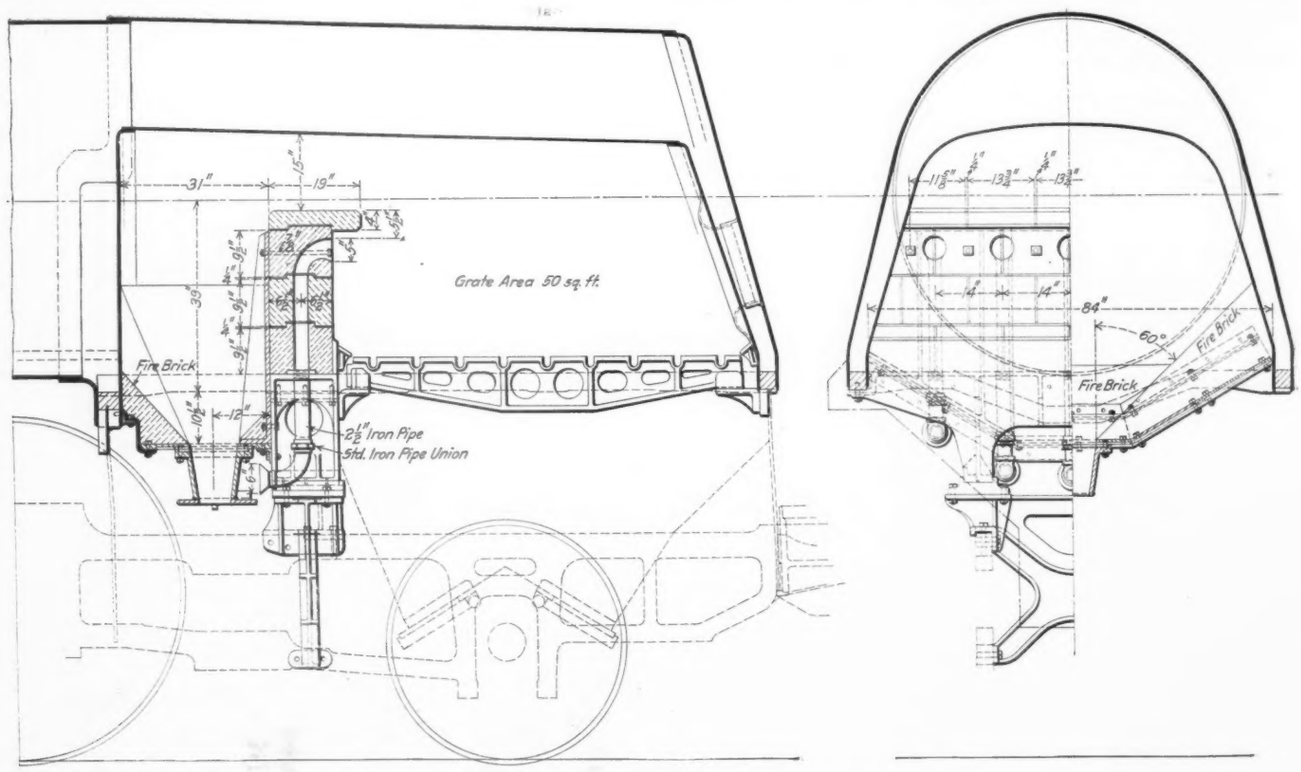
[Criticisms of any of the operations or suggestions in this article will be welcomed.—Editor.]

Accident Record.—The Pennsylvania Lines west of Pittsburgh carried, during the calendar year ending December 31, 1911, 32,558,337 passengers, who traveled 1,138,329,577 miles; and not one was killed in any train accident. The Vandalia Railroad, which is a part of this system, has maintained a similar record for five years, and during that time has recorded only 46 passengers injured in train accidents, this number including every case requiring medical or surgical attention, however trivial. The Grand Rapids & Indiana reports a similar freedom from fatal accidents to passengers for five years. It is expected that these records will be beaten next year.

PACIFIC TYPE LOCOMOTIVE WITH GAINES FIREBOX

In the February, 1912, issue of the *American Engineer*, F. F. Gaines, superintendent of motive power of the Central of Georgia, discussed at some length the theories of flame action in a locomotive firebox which led to the design of the Gaines firebox. The constructional features were also illustrated in the same article and a comparative test was reported showing a decided economy in favor of this design. The 2-8-0 type locomotive on which these tests were made has been in regular service for over three years, giving no trouble from leaky tubes or steam failure, and has continued to give the fuel saving it demonstrated on the test.

This experience has led to the application of the same type of firebox to six Pacific type locomotives recently delivered to the Central of Georgia by the Baldwin Locomotive Works. These are moderately heavy, having 23 in. x 28 in. cylinders, 69 in. drivers and 180 lbs. steam pressure. They are essentially modern in every detail, being equipped with Schmidt superheaters, outside steam pipes, front extension of piston rod, etc., but present few features of novelty outside of the firebox construction.



Sections Through Gaines Firebox on 4-6-2 Type Locomotive; Central of Georgia.

One of the illustrations shows the sections through the firebox and it will be seen that the level of the grates is somewhat above the bottom of the barrel of the boiler. This permits an unusually large and deep ash pan. While the area inside the mud ring is 77 sq. ft., the actual grate area is but 50 sq. ft., giving practically 50 per cent. greater volume in the firebox than would be provided by the ordinary grate at the same level. It will also be noted that with this arrangement it would have been possible, with very slight changes in the boiler, to have placed a fourth driver under the firebox, if such construction had been desirable. A comparison of the ratios, as shown in the table below, will indicate, based on the actual grate area, that this locomotive is about the average practice for proportions of weight, heating

surface, etc. When the increased efficiency of the firebox heating surface, in addition to its proportionally larger amount, is considered, there seems to be but little question but what these locomotives will have a very large average evaporation per sq. ft. of total heating surface. The short stroke, superheated steam, double ported piston valves and highly efficient heating surface will probably make it possible for them to deliver a larger proportion of the rated tractive effort at high speeds than any other locomotive of the same weight now in service.

In constructional features, the design follows the most approved practice. Frame bracing has been very fully provided by cast steel braces secured to both rails of the frame at three different points between the cylinders and the firebox. The frames are of open hearth steel with single front rails cast integral with the main sections. The back sections are separate and designed to accommodate the Hodges type of trailing truck. Both injectors are on the right side feeding through a double check valve. The dome is flanged from a single piece of steel plate and is noticeable on account of its size, being 33 in. in diameter and 24 in. high. Flexible staybolts are liberally used in the water legs. Two 16 in. circular fire doors are provided and the O'Connor door flange has been applied. Forged and rolled steel wheels are used under the tender and for the front engine truck.

The general dimensions, weights and ratios are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Passenger
Fuel	Bit. coal
Tractive effort	32,800 lbs.
Weight in working order	222,300 lbs.
Weight on drivers	134,850 lbs.
Weight on leading truck	43,150 lbs.
Weight on trailing truck	44,300 lbs
Weight of engine and tender in working order	360,000 lbs.
Wheel base, driving	12 ft.
Wheel base, total	31 ft. 6 in.
Wheel base, engine and tender	63 ft. 9½ in.

Ratios.

Weight on drivers ÷ tractive effort	4.12
Total weight ÷ tractive effort	6.78
Tractive effort × diam. drivers ÷ heating surface*	631.00
Total heating surface* ÷ grate area	71.90
Firebox heating surface ÷ total heating surface*, per cent	4.55
Weight on drivers ÷ total heating surface*	37.50
Total weight ÷ total heating surface*	62.00
Volume both cylinders, cu. ft.	13.46
Total heating surface* ÷ vol. cylinders	266.00
Grate area ÷ vol. cylinders	3.72

Wheels.

Driving, diameter over tires	69 in.
Driving, thickness of tires	3½ in.
Driving journals, diameter and length	10 x 12 in.
Engine truck wheels, diameter	33½ in.
Engine truck journals	6 x 12 in.
Trailing truck wheels, diameter	48 in.
Trailing truck journals	8 x 14 in.

Cylinders.

Kind	Simple
Diameter and stroke	23 x 28 in.

Valves.

Kind	Double ported piston
Diameter	12 in.

Boiler.

Style	Straight
Working pressure	180 lbs.
Outside diameter of first ring	70 in.
Firebox, length and width	132 x 84 in.
Firebox plates, thickness	⅜ and ½ in.
Firebox, water space	F.—4½ in.; S. & B.—3½ in.
Tubes, number and outside diameter	194—2 in.
Tubes, thickness	No. 12, B. W. G.
Flues, number and size	28—5⅜ in.
Flues, thickness	No. 9, B. W. G.
Tubes, length	18 ft.
Heating surface, tubes	2,526 sq. ft.
Heating surface, firebox	163 sq. ft.
Heating surface, total	2,689 sq. ft.
Superheater heating surface	605 sq. ft.
Grate area	50 sq. ft.

Tender.

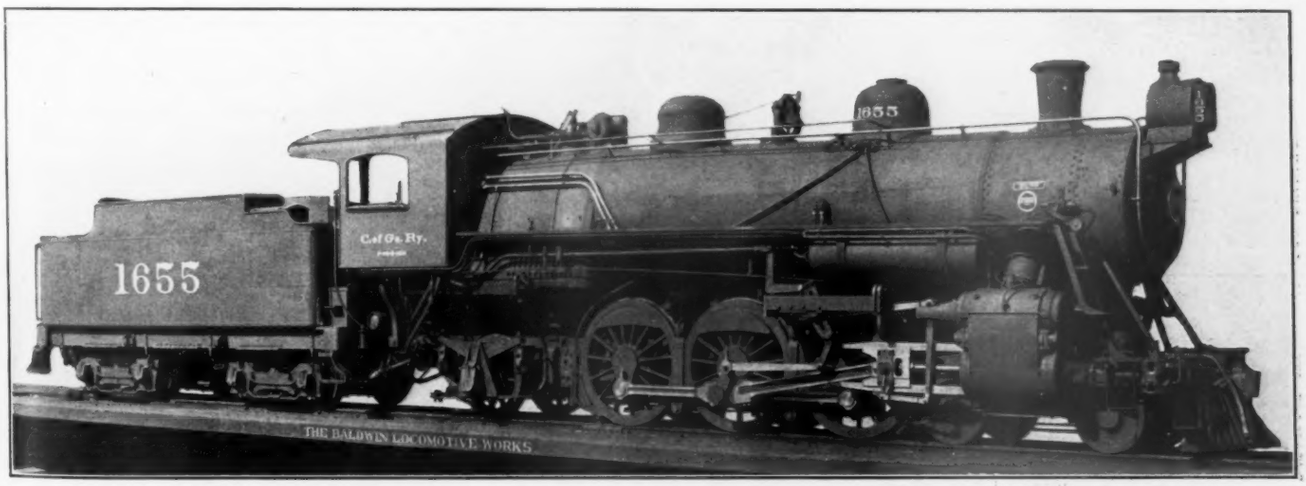
Tank	Water bottom
Frame	12-in. 40-lb. channels
Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	7,500 gals.
Coal capacity	13 tons

*Equivalent heating surface equals 2,689 sq. ft + (1.5 × 605 sq. ft.) = 3,597 sq. ft.

DOUBLE DRILL WITH INDEPENDENT HEADS

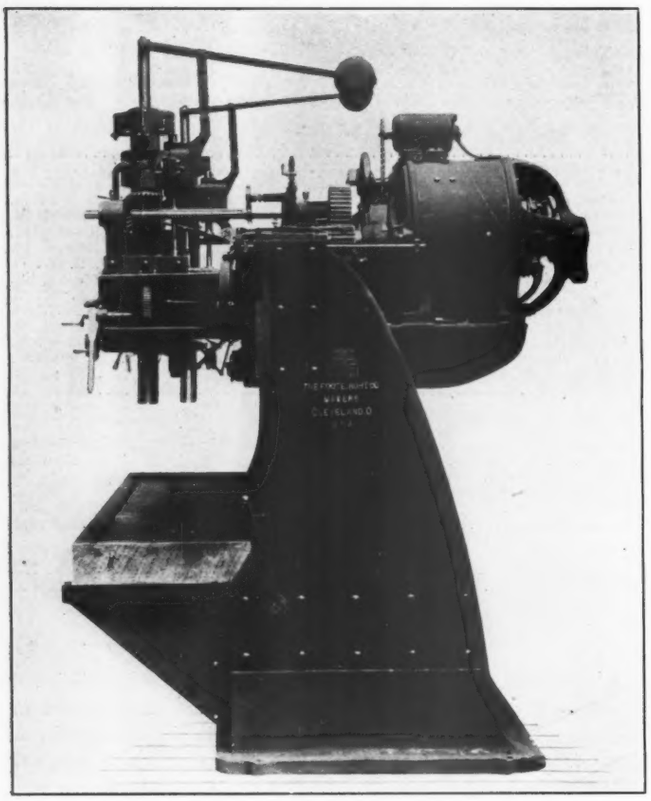
A powerful, simply arranged, double-headed drill, designed primarily for work on mud rings and flue sheets, is shown in the accompanying illustration. This machine is suitable for a general line of heavy work as well as the specialties to which it is particularly fitted, and is arranged so that each of the two heads is an independent and self-contained unit, permitting maximum flexibility in operation and allowing the correct feeds and speeds to be used on each spindle independently. The heads have an in and out adjustment of 8 in. on the knee which, in connection with the 24 in. adjustment of the table in the same direction, makes it possible to cover a large area with one setting.

As will be seen in the end view of the machine, the saddles carrying the heads and motors are of massive design and are carried by a very heavy cross-rail. By mounting the motors in the manner shown, the drive is greatly simplified. On the armature shaft is a rawhide pinion meshing with a coarse pitch spur gear which drives through a single pair of bevel gears made of forged steel with planed teeth, carefully heat treated and hardened. From this point the drive to the spindle is through spur



Pacific Type Locomotive with Gaines Firebox, Schmidt Superheater and Double Ported Piston Valves.

gears. Each spindle has an individual clutch allowing it to be stopped and started at will without stopping the motor.



End View of Mud Ring and Flue Sheet Drill.

The motors are 7½ h. p. of the armature shifting type, manufactured by the Reliance Electric & Engineering Company, of Cleveland, Ohio. They give a speed range of from 200 to 1600 revolutions without the use of gearing. The shifting of the armature is accomplished by a small motor mounted on the large motor and connected to the shifting mechanism through sprockets and a chain.

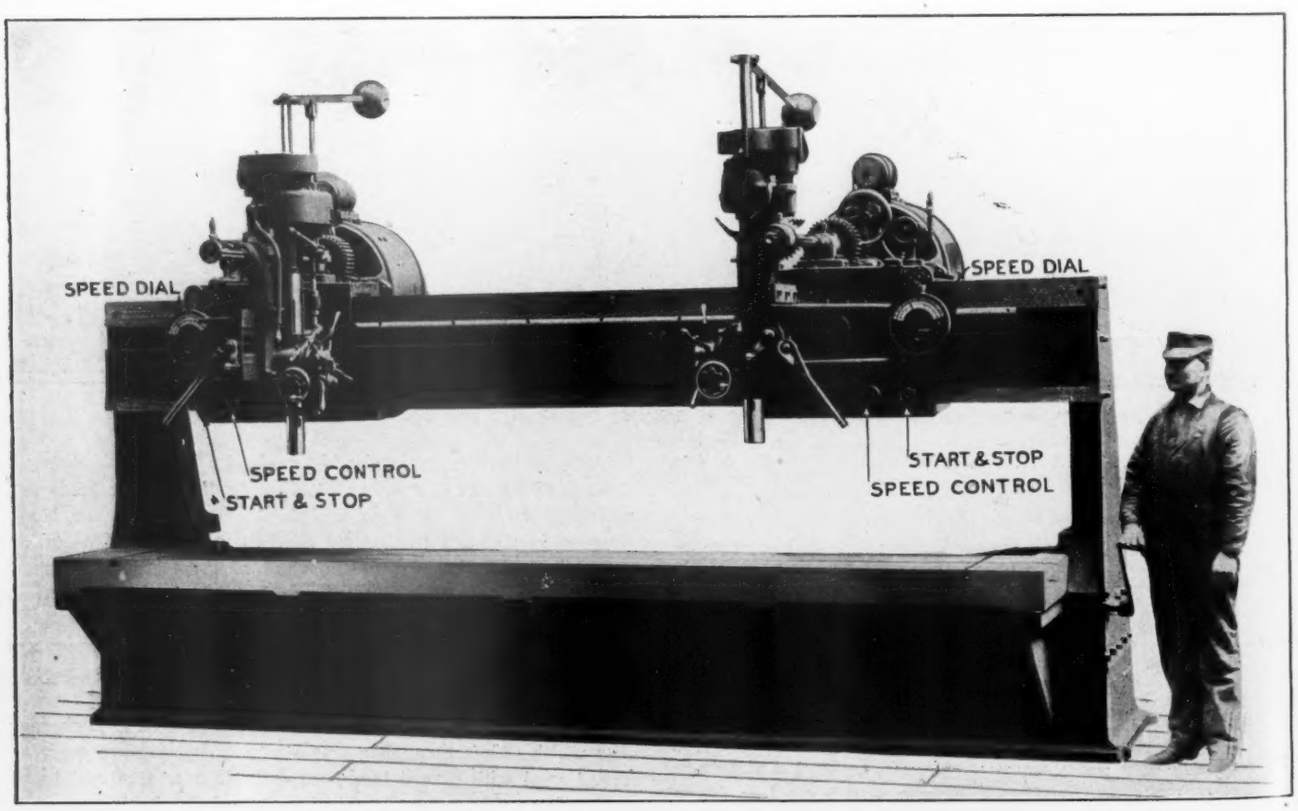
A quick change gear device, controlled by a lever within easy reach of the operator, gives the three feed changes. Each spindle is provided with an individual oil pump having its own tank, allowing it to be operated independently and insuring delivery of the cutting compound to the drill under all circumstances. The power feeds are provided with an automatic stop as well as the usual hand knock-off and clutch. Ball thrust bearings are used in connection with the spindles and feed worms.

Guess work in setting the speed of the motor to give the best results for each piece of work is avoided by the application of a Reliance speed dial on each head. This dial has two scales on its face; the upper one is graduated to show cutting speeds in feet per minute, and the lower one gives the various sizes of drills. The dial is first set for the cutting speed desired, and the speed of the motor is then adjusted until the pointer is opposite the size of the drill to be used. The stopping and starting of the motor is controlled by automatic starters operated by push buttons.

When working on mud rings, the brackets supporting the table are removed and special mud ring chucks are placed on the table, which is run back between the housings. These brackets are doweled in position, allowing them to be readily removed and replaced.

Some of the more important dimensions of this tool, which is built by the Foote-Burt Company, Cleveland, Ohio, are given in the following table:

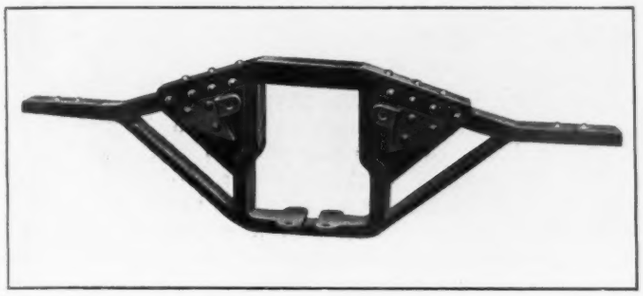
Clear width between housings	14 ft. 4 in.
Maximum distance from spindle to top of table	21½ in.
Length of power feed	12 in.
Maximum distance center to center of spindles	10 ft.
Minimum distance center to center of spindles	18 in.
Working surface of the table	24 in. x 14 ft. 4 in.
Spindle speeds	37 to 347
Diameter of spindle in sleeve	2¼ in.
Weight of machine	28,000 lbs.



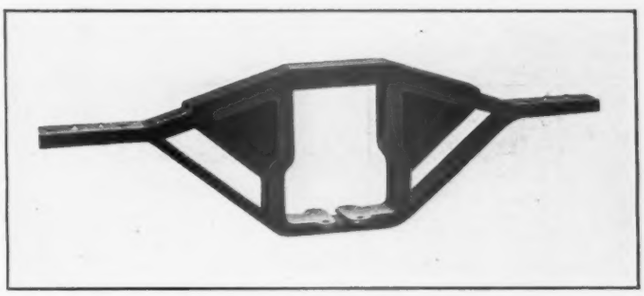
Mud Ring and Flue Sheet Drill with Independent Motor Driven Heads.

ROLLED STEEL TRUCK SIDE FRAMES

A truck side frame for freight cars is built by the Murphy Equipment Company, New York, which is made up entirely of rolled steel. The various members may be either welded or riveted together as shown in two of the accompanying illustrations. The oxy-acetylene process is used on the welded frame as well as for welding the gusset plate on the riveted frame. A rolled steel channel is bent to form part of the compression member and the column guides, as shown in the drawing. This is reinforced by two gusset plates of ⅜-in. material and a ¾-in. cover plate extending across above the bolster and completing the compression member. All the connections are either riveted or welded and in this way a solid frame of steel is formed without the use of bolts, nuts or castings. The column guides have an enlarged opening at the base for the insertion of the bolster.



Riveted Truck Side Frame.



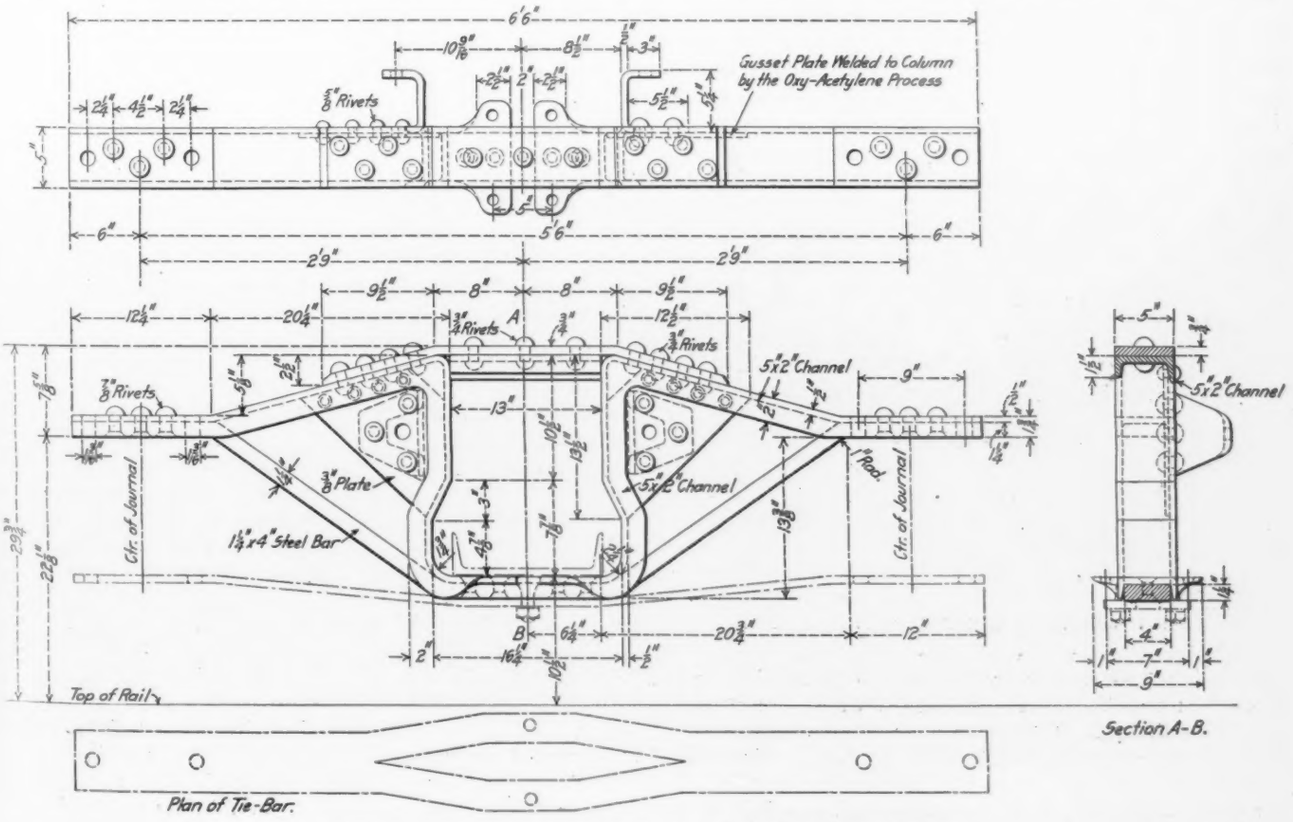
Welded Truck Side Frame.

These frames have been tested and the following is a report of a test of a riveted side frame made for an 80,000-lb. capacity car, a drawing of which is shown herewith. There is a slight difference, however, between this frame and the one tested, in that the tested frame had only two ¾-in. rivets over the journal box instead of three, as shown, and the gusset plates were riveted instead of welded. The frame was supported the same as it would be in service, the journal box being replaced by a pair of steel clamps. The deflection was measured by a straight edge secured to the tension member and gage points at the journal box supports. The frame was evenly loaded by means of a hydraulic press and the accompanying table shows the results obtained.

The frame was then loaded to destruction and at 412,000 lbs. the ¾-in. rivets over the journal box at one side sheared. The other connection remained intact but was apparently strained. The compression member showed very little distortion, but the tension member elongated ⅞ in. The frame was

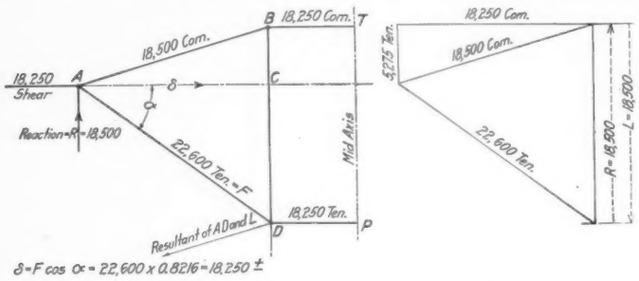
TESTS OF MURPHY TRUCK SIDE FRAME.

Load.	Deflection.	Permanent Set.
80,000 lbs.	⅛ in.	none.
100,000 lbs.	5/32 in.	none.
120,000 lbs.	3/16 in.	none.
160,000 lbs.	¼ in.	none.
180,000 lbs.	⅜ in.	none.
210,000 lbs.	9/16 in.	⅛ in.



Riveted Truck Side Frame Built Up of Rolled Steel Members.

straightened and the rivets that sheared were re-driven. It was then bolted to the columns of the hydraulic press through the journal box holes and a side load was applied at the center of the column guides, approaching as nearly as possible the loads that would occur in practice, due to the side thrust from the bolster. The frame began to take a permanent set in a sidewise direction at a load of 115,000 lbs. and with a load of 167,000 lbs. the set became quite noticeable, approximating 5/8 in. The load was gradually increased until it reached 232,500 lbs.,



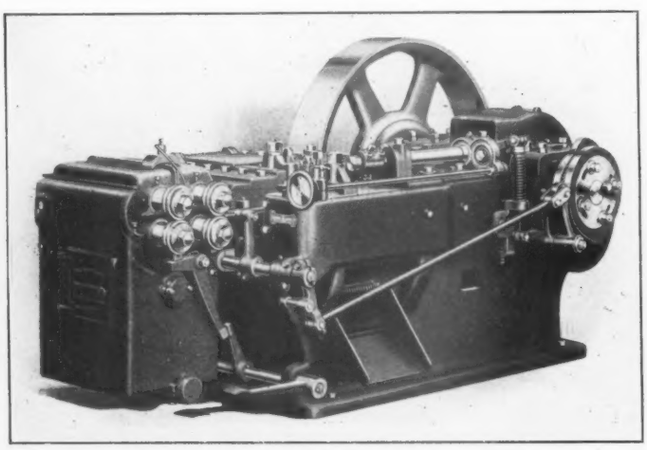
Stress Diagram of Murphy Truck Side Frame.

at which point the frame was badly bent and the permanent deflection was found to be 1⅞ in. The plate on the compression member between the two column guides was displaced and all of the connections were strained.

These frames are claimed to be stronger, lighter and much cheaper than cast steel, being considered immune from crystallization due to shocks and vibrations. They are designed to conform to all the M. C. B. requirements. Any design of brake hanger may be used with them.

AUTOMATIC FEED FOR BOLT HEADER

In many cases the output of a bolt header depends entirely on the ability of the operator to withstand the fatigue of continued rapid movement. Even with a helper it is not always possible for a man to develop the full capacity of the machine because of his physical limitations. This difficulty has been largely overcome by an automatic feed for bolt or rivet headers that has been designed by the National Machinery Company, Tiffin, Ohio.



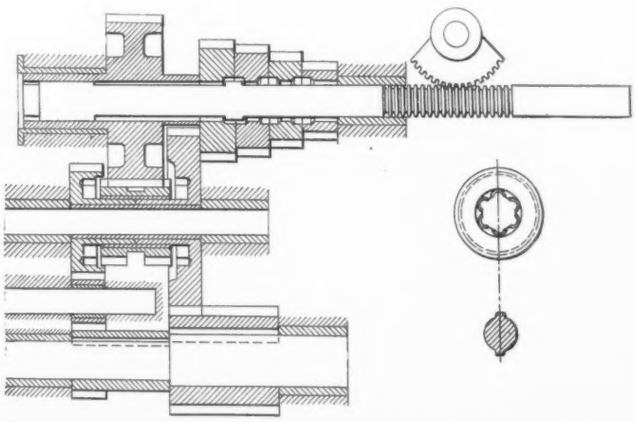
Bolt Header Fitted with Automatic Feed Rolls.

With this attachment long rods in mill lengths, taken on the initial heat or reheated in special long furnaces, are started in the feed rolls by the operator and are advanced automatically, the blank sheared and headed and a finished bolt or rivet ejected at each revolution of the machine. This attachment is suited for work on any type of single blow work, i. e., a bolt or rivet head formed by one blow of the machine. The feed rolls are chilled castings and water jacketed, insuring the minimum wear on the feeding surface and a steady uniform feed.

On the machine to which this automatic feed is applied a new type of stock gage is employed. This is designed not only to allow rapid and accurate adjustment while the machine is in operation, but also to eliminate all spring and secure uniformity in the quality of the product. An increase in output of from 50 to 100 per cent. has been obtained in shops where this type of automatic machine has been substituted for the hand feed type.

ROCHESTER HORIZONTAL BORING MILL

A new machine of unusual interest and embodying many original and novel features has recently been designed by the Rochester Boring Machine Company, of Rochester, N. Y. Although this machine comes within the general classification of a boring mill, a more accurate name would be, a boring, milling, drilling and tapping machine, since it is arranged to perform all of these functions proficiently, accurately and conveniently. It can also be used for splining, oil grooving and thread cutting. While this may seem to be a very wide range of work for one machine, reference to the illustration will show that the design is without complication. On the contrary it is marked by extreme simplicity when its size and range of work are taken in consideration. Possibly the most striking feature is the centralized control that permits every change of feed, speed or traverse in every direction, as well as the starting, stopping and reversing, to be made from a position of the operator which allows



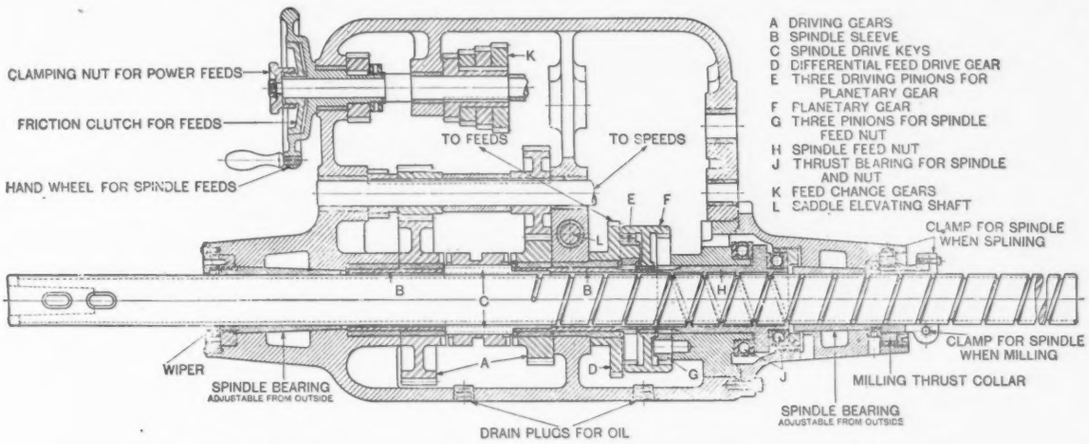
Arrangement of Gearing for Feed Changes and Reverse.

him to closely observe the work of the cutter at the same time. The arrangement in the head will not allow two conflicting levers to be engaged at the same time.

All the driving and feeding mechanism is centralized in the saddle or head, insuring maximum efficiency of power by the elimination of many shafts, joints and gears. The aim throughout the machine has been to make the drive as direct as possible, so that the power is used for doing work and not for overcoming the friction of the machine itself. When the machine is motor driven, the power is applied direct to the vertical driving shaft and when belt driven it is applied through bevel gears from a horizontal shaft. A clutch for starting and stopping is provided in the main driving pulley of the belt driven type.

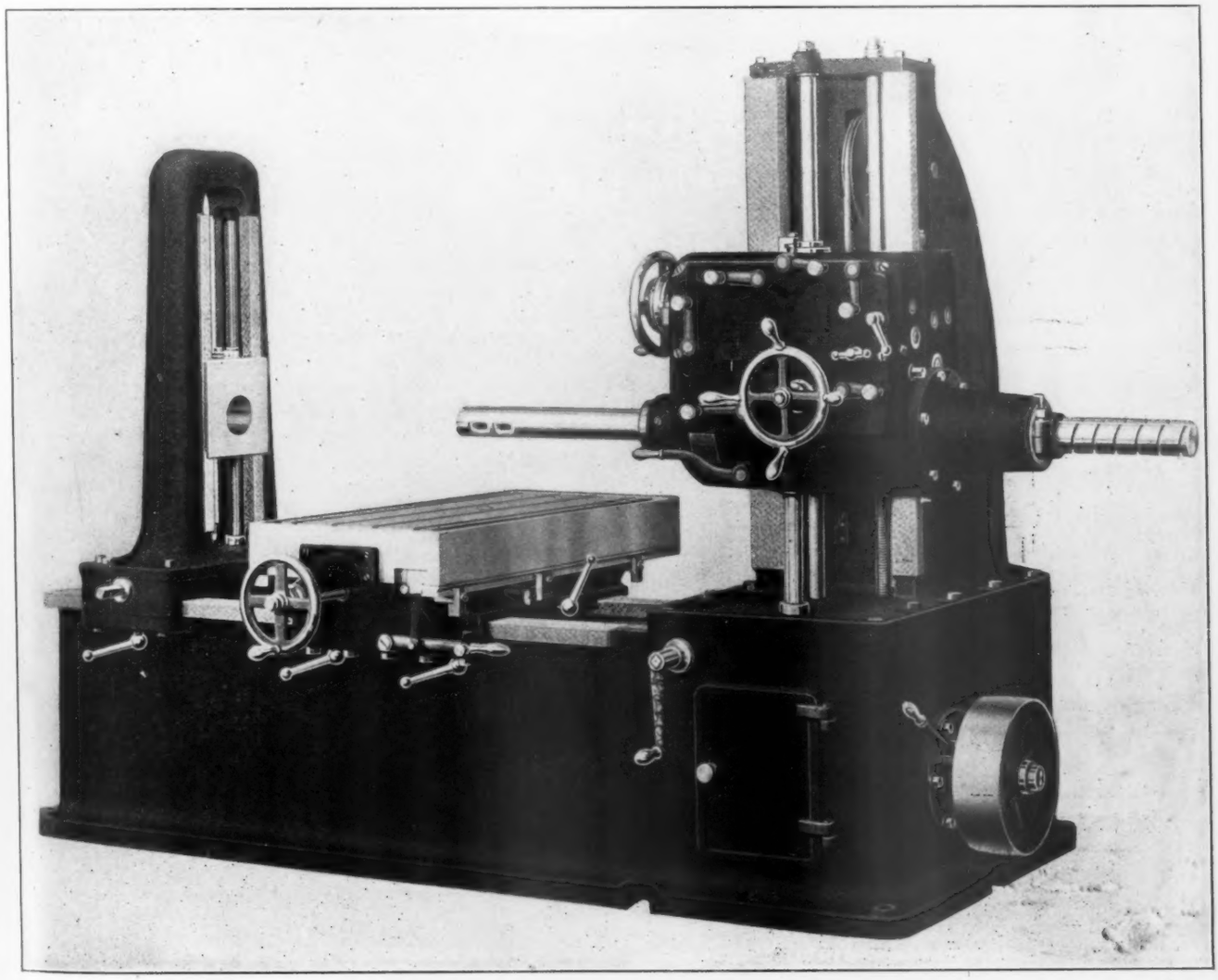
One feature in particular that has made possible the centralized control and simple design, is the ingenious method employed for feeding the spindle. This is arranged on a screw feed principle, providing a continuous feed for any length of spindle and applied concentric with it, between its two main bearings, thereby doing away with the heavy overhanging strongback at the end of the saddle generally required by the rack and pinion feed. One of the illustrations shows a sectional view which per-

mits the details of this construction to be understood. It will be noticed that the spindle has its own independent bearings at the extreme ends of the saddle, giving a very rigid support. A spindle sleeve on which the driving gears are mounted also has the spindle. The spindle sleeve *B* has gear teeth cut in one end which mesh with the three pinions *E*, mounted on studs that form part of the differential feed driving gear *D*. Through the double internal gear *F* and three pinions *G*, which mesh in the


A DRIVING GEARS
B SPINDLE SLEEVE
C SPINDLE DRIVE KEYS
D DIFFERENTIAL FEED DRIVE GEAR
E THREE DRIVING PINIONS FOR PLANETARY GEAR
F PLANETARY GEAR
G THREE PINIONS FOR SPINDLE FEED NUT
H SPINDLE FEED NUT
J THRUST BEARING FOR SPINDLE AND NUT
K FEED CHANGE GEARS
L SADDLE ELEVATING SHAFT
CLAMPING NUT FOR POWER FEEDS
FRICTION CLUTCH FOR FEEDS
HAND WHEEL FOR SPINDLE FEEDS
TO FEEDS
TO SPEEDS
CLAMP FOR SPINDLE WHEN SPLINING
CLAMP FOR SPINDLE WHEN MILLING
MILLING THRUST COLLAR
WIPER
SPINDLE BEARING ADJUSTABLE FROM OUTSIDE
SPINDLE BEARING ADJUSTABLE FROM OUTSIDE
DRAIN PLUGS FOR OIL

Section of the Saddle Showing the Driving and Feeding Mechanism on the Spindle.

its bearings in the casing, and clearance is provided between the sleeve and saddle, avoiding any possiblity of transmitting vibration to the work. The spindle is rotated by the long spline keys fitted in the driving sleeve and engaging the double splines in saddle feed nut, *H*, the latter is rotated at the same speed and in the same direction as the spindle as long as the feed driving gear *D* remains stationary, which is the case when the feeds are disengaged. When the feed is applied and the driving gear *D*

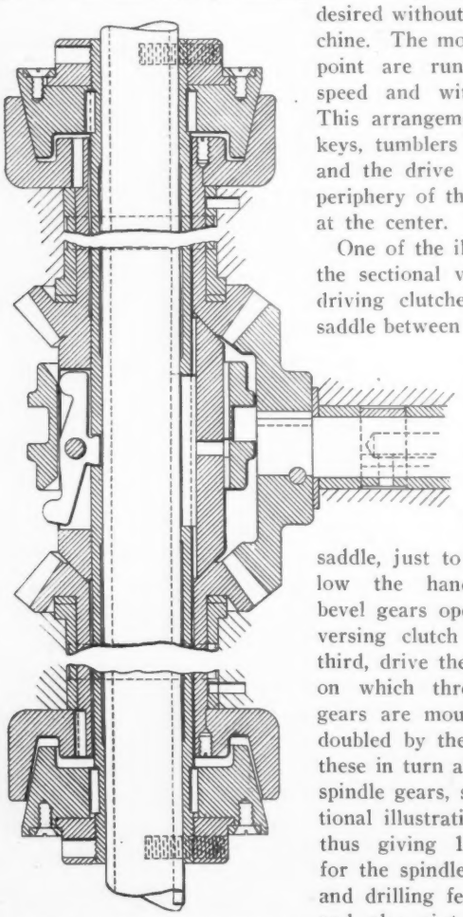


Horizontal Boring, Drilling, Milling and Tapping Machine.

rotates, the speed of the feed nut *H* will be different from that of the spindle in either direction, and at a speed in proportion to the movement of *D*, thus giving a feed to the spindle. The feed nut comes in contact with the sides of the thread on the spindle only, and the end thrust in either direction is taken on ball bearings of large diameter. End thrust when milling is taken direct on the saddle through bronze bearings, which do not come in use when boring. Positive planetary gearing is arranged for controlling the movement of the spindle from the hand wheel, which permits its adjustment either at rest or when running.

All feeds before being applied to the different parts are transmitted through a friction clutch, and since all feeds are taken from the shaft that rotates the spindle, they are in direct ratio to the revolutions of the spindle.

A feed reverse mechanism is provided at the source of the power for the feed, permitting it to be quickly reversed when desired without stopping the machine. The moving parts at this point are running at a good speed and with a light load. This arrangement eliminates all keys, tumblers and bevel gears, and the drive is applied at the periphery of the gear instead of at the center.



Driving Clutch on Rochester Boring Machine.

One of the illustrations shows the sectional view of the main driving clutches located in the saddle between the column ways. The operating lever for starting, stopping and reversing the machine is conveniently located at the front of the saddle, just to the left and below the hand wheel. Two bevel gears operated by the reversing clutch and engaging a third, drive the first speed shaft on which three speed change gears are mounted. These are doubled by the back gears, and these in turn are doubled by the spindle gears, shown in the sectional illustration of the saddle, thus giving 12 speed changes for the spindle. Sixteen boring and drilling feeds are provided, and also sixteen milling feeds for the saddle and the table. Power rapid traverse at constant speed and independent of the feeds is provided for the spindle, saddle, table and carriage, and automatic limit stops are arranged for movements in all directions in addition to adjustable stops for the feeds of the table.

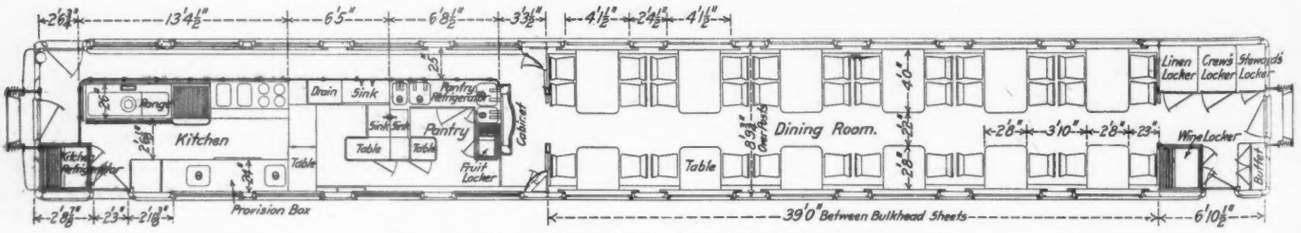
All gearing in the saddle is enclosed and runs in oil. A pump lifts the lubricant to a reservoir at the top of the saddle from which it is distributed by pipes to the different bearings, the overflow running over the gears. The operation of this system is entirely automatic.

The feeds and traverses in the saddle are transmitted to the table by the vertical shaft from the bottom of the saddle connecting through bevel gears to a horizontal shaft in the bed. At the table, the feed is distributed either to the cross feed of the table or to elevate the saddle and outer support. While power feed for lateral motion of the table is not included, it can be supplied when specified. All screws giving movement to the table are located between the ways in the center of the resistance, so that all tendency of swiveling or cramping action is avoided. The nuts on the screws for the various traverses are made in two parts to provide for taking up wear and back-lash, and all nuts rotating on screws have bearings independent from the shaft on which they operate.

When the machine is used for splining, the spindle gear clutch is brought to a neutral position disengaging the spindle driving gears and a key is inserted in the milling clamp collar at one end of the saddle. The milling clamp collar is secured to the spindle by a friction band tightened by a thumb screw on the outside of the bonnet, and the key engages one of the spline ways in the spindle. The power rapid traverse is then employed for driving the spindle in and out, but without rotating it. Spiral oil groove cutting of different pitches can also be obtained with this machine by using the power rapid traverse for traveling the spindle, and at the same time engaging one of the spindle speeds, thereby rotating it at the same time. By combining the direct and back gears for the feeds, and the 12 speed changes of the spindle, different pitches of oil grooves or threads can be cut. When cutting spiral oil grooves the clamping collar used for splining is disengaged. These machines are now being built in two sizes, one with a 3 in. spindle, and one with a 3½ in. spindle.

A DINING CAR WITHOUT VESTIBULES

By omitting the platform and vestibule at each end of the car, the Pennsylvania Railroad, in its latest equipment of this type, has been able to increase the seating capacity of dining cars by six, making it possible to serve thirty-six people at one time. The cars are all-steel, of the standard Pennsylvania cantilever type, and measure 83 ft. in length over-all. They weigh 147,500 lbs. It will be noticed in the plan that side doors are provided at each end of the car for convenience in stocking the steward's and kitchen departments. No steps or trap doors have been installed and these doors are not to be used for entrance or exit. Reference to the floor plan will show that the pantry and serving arrangements have been carefully studied to facilitate the work of the waiters as much as possible. The result of this arrangement is shown by a recent demonstration when in one of these cars 108 people were served in three hours with no rushing or crowding. The pantry is separated from the main body of the car by a sliding door, and electric fans with liberal ventilator equipment in the kitchen, prevent all odors from gaining access to the dining section. The car has the usual design of six-wheel trucks used on all of the heavier Pennsylvania steel equipment. These are placed at 56 ft. 3 in. centers.

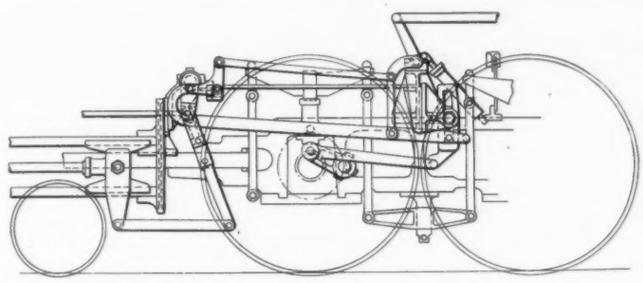


Plan of a New Pennsylvania Car that Seats 36 Persons.

VARIABLE LEAD ATTACHMENT ON WALSCHAERT VALVE GEAR*

In certain classes of service the variable lead given by the Stephenson valve gear permits the locomotive to accelerate more rapidly and to better adjust itself to different operating conditions, than is possible with the Walschaert valve gear, giving a constant lead at all points of cut-off.

To overcome this difficulty, William L. Davis, roundhouse foreman of the Santa Fe in Chicago, has designed and patented a construction which automatically gives, with a regular Walschaert valve gear, a lead varying in amount with the point of cut-off, giving valve events practically duplicating those obtained with a Stephenson valve gear. In addition to providing a variable lead, this construction also permits a convenient adjustment of the amount of the lead.



Davis Variable Lead Attachment.

Since the amount of lead with the Walschaert valve gear depends on the relation of the distance from the valve stem connection on the combination lever to the connection with the radius rod, and from the latter to the union link, it will be seen that if the ratios of these two distances can be changed the lead will be altered in the same proportion. To do this, Mr. Davis' construction provides a block, sliding in guides in the combination lever, to which the front end of the radius rod is connected. This block is supported by a link carried from a bell crank fulcrumed on the cross casting that supports this part of the valve gear. The upwardly projecting arm of this bell crank is connected, by a long rod, to the arm on the lift shaft that carries the hanger to the radius rod.

As will be seen by reference to the drawing, the arm on the lift shaft is so proportioned that as it is drawn upward the connection to the bell crank will move forward. This, in turn, will lower the link, carrying the block in the combination lever, and thus increase the distance between the connection of the radius rod and the valve stem, and increase the lead. The reverse action of course takes place as the lift shaft is dropped down and the cut-off increased.

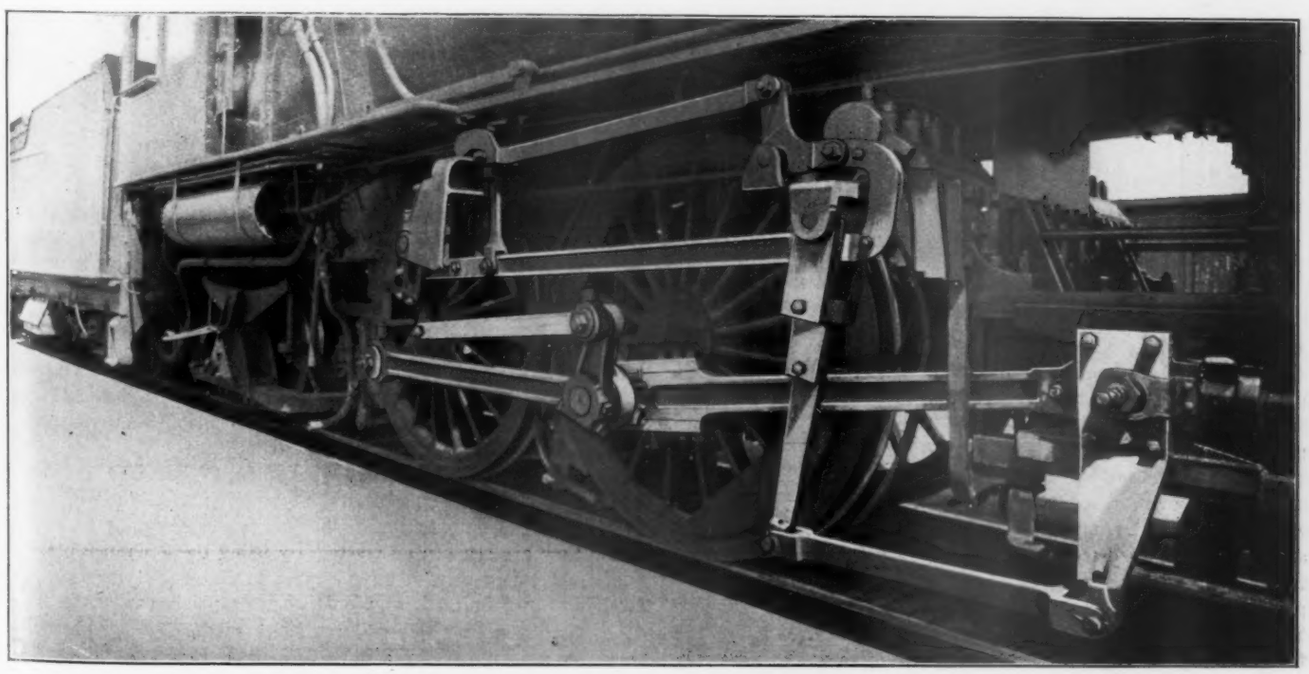
On a locomotive fitted with a regular Walschaert valve gear, it was found that the cut-off in full gear was 21 in. After the Davis attachment was applied the cut-off was 23½ in., the lead at running position being the same. A year's trial has proved the practicability of the construction and the fears that there would be excessive wear on the sliding blocks in the combination lever have proved unfounded. These blocks have a maximum travel of 1¼ in., and have practically no movement except as the point of cut-off is changed.

*See also *American Engineer & Railroad Journal*, December, 1911, page 499.

GAS-ELECTRIC CARS FOR THE FRISCO.

The St. Louis, Brownsville & Mexico, one of the lines of the Frisco system, has ordered two gas-electric motor cars of the GE-70-B-11 type from the General Electric Company, Schenectady, N. Y. These cars will be built with side entrances for the passengers and a rear door for the use of the conductor when the cars are coupled to trailers. The Frisco system will now have 17 of these cars running on regular schedules over its lines operating between the following points: Brownsville, Tex., and Mission; Orange and Newton; Madill, Okla., and Ardmore; Westville and Muskogee, Lawton, Okla., and Quanah, Tex.; Eunice, La., and Crowley; Dallas, Tex., and Sherman; Enid, Okla., and Bailey; Salem, Mo., and Cuba; Bolivar and Chadwick. The cars are capable of running about 60 m. p. h. on a level stretch and will average 25 to 35 m. p. h. schedule speed with stops two to three miles apart.

The new cars are 70 ft. 5 in. long and are divided into four compartments, one for passengers, which is 33 ft. long; a smok-



Davis Variable Lead Attachment Applied to a Balanced Compound 4-4-2 Type Locomotive.

ing compartment, 10 ft. long; a baggage compartment, 11 ft. long and the engine room, 12 ft. long. Each car has a seating capacity for 92 passengers, each seat accommodating 3 persons, and the net weight of the car is approximately 50 tons. It is of all-steel construction, except the interior finish, which is of mahogany and composite board. The frame is made up of steel I-beams and channels, with steel plates for the outside sheathing. The under floor is made of wood, having sheet iron on the lower side. A heavy felt lining is inserted between the wood and the iron. The sides of the car are also insulated with felt. The steel roof and the rear of the car are of the turtle back design. The seats are covered with friezette plush in the passenger compartment and genuine Spanish leather in the smoking room. The entire car is lighted with electricity.

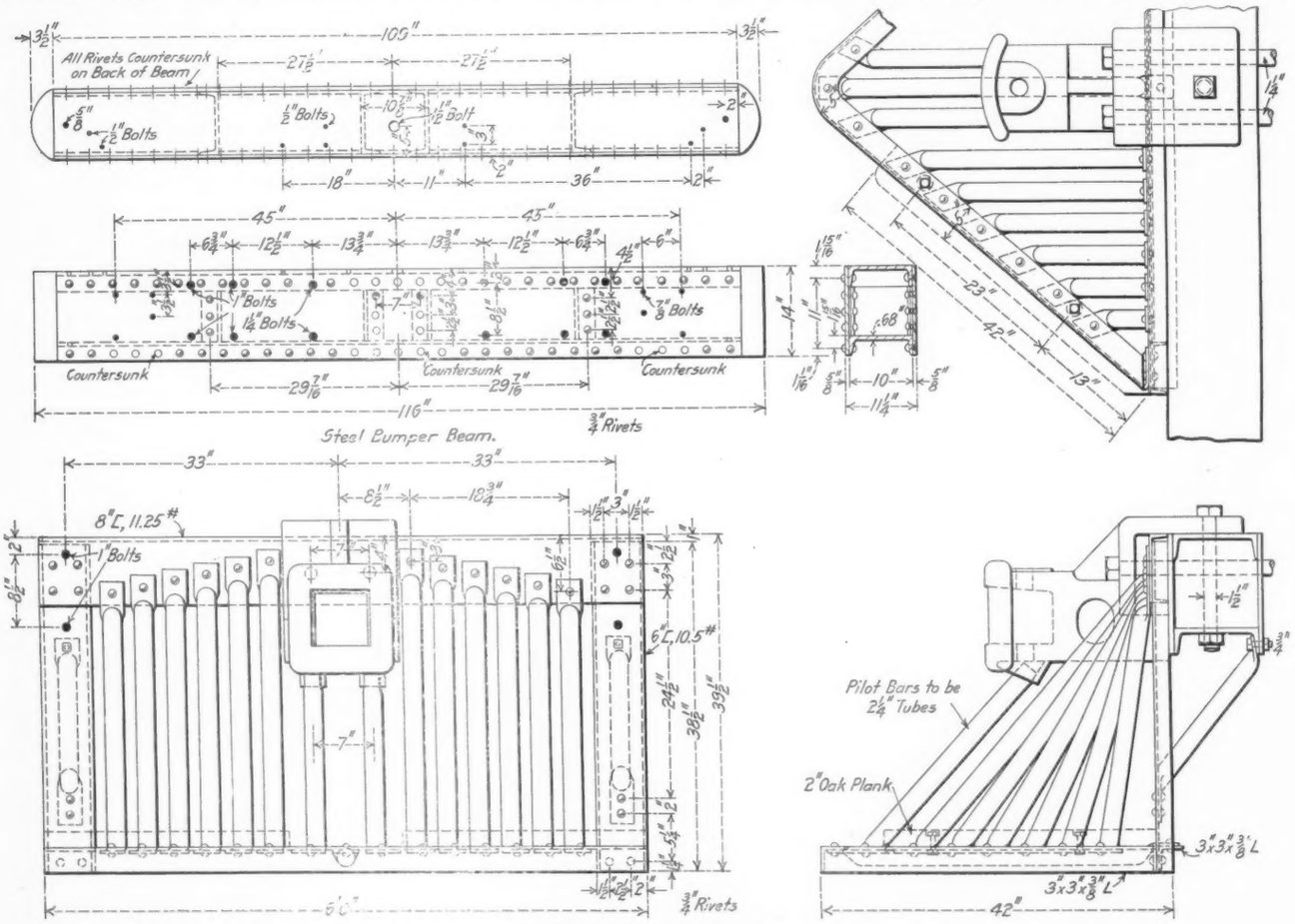
The engine is an 8-cylinder, 4-cycle gas engine of the *V* type and is direct connected to a 600-volt generator, which is designed to meet the special conditions of this service. The engine is started by compressed air taken from the main reservoirs of the air brake system. The main air compressor is driven from the crank shaft of the main engine and is fitted with an automatic governor which maintains a constant pressure. An auxiliary two-cylinder, 4-cycle engine operates a single cylinder air compressor and the lighting generator. This set is used for supplying the initial charge for starting the main engine. Two railway motors of the GE-205-600 volt, box frame, oil lubricated, commutating pole type having 100 h. p. capacity, are mounted on the axles of the forward truck. The voltage of these motors is governed by varying the strength of the generator field and they are placed in series or parallel by means of a special controller. Separate handles are also provided for throttling the engine and for reversing the car, the latter being accomplished by changing the motor connections in the usual manner, without stopping the engine. All the handles are in easy reach of the operator.

The trucks are of the swing bolster type, having elliptic and coil springs. The bearings, wedges and the contour of the wheels conform to the M. C. B. standards. The brake equipment includes the hand and the combined straight and automatic air brakes. A hot water heater, coal fired, is used for heating the car and to prevent the freezing of the engine circulating water.

ALL-STEEL PILOT

BY ARTHUR J. BELAND.
Duluth & Iron Range, Two Harbors, Minn.

Owing to the scarcity of suitable timber a demand has arisen for all-steel beams and pilots for locomotives; the accompanying illustration shows a steel pilot that is made from scrap material and a steel bumper built up of structural shapes. The bumper is made up of two 10-in. channels 109 in. long extending across the top and bottom, being connected by two 5/8-in. side plates 14 in. wide. The side plates are further strengthened by 4 pieces of 10-in. channel 7 7/8 in. long, riveted in a vertical position between the two sides. The rivets on the inside of the bumper are countersunk to provide a smooth surface for the connection to the frame and front foot plate.



All-Steel Pilot and Bumper.

The frame of the pilot may be made of bar iron or steel, and the bars are of scrap locomotive boiler tubes. The tubes are heated and the ends flattened and bent to fit the pilot frame to which they are secured by rivets. By using these scrap tubes, of which there is always a large supply in the scrap yard, an all-steel pilot may be made at a cost of not much greater than that of a wooden pilot. The end posts are made of 6 in. channels to which are riveted the 3 in. x 3 in. x 3/8 in. angles that form the bottom frame. The 2 in. oak plank indicated by the dotted lines show how the step may be applied.

GENERAL NEWS SECTION

The names of 21 employees were added to the pension roll of the Rock Island Lines during the month of May, increasing the total number of pensioners to 134.

The educational bureau of the Union Pacific is planning a series of motion picture exhibitions showing correct and incorrect ways in which employees do things in different branches of the service. The pictures will be accompanied by explanatory lectures to be delivered before meetings of employees at division points all over the system.

The Chicago, Milwaukee & St. Paul, and two of its employees have been indicted in connection with the collision at Odessa, Minn., last winter. The railway company and L. Gillic, conductor of the passenger train, which was struck by the following section, were indicted on a charge of manslaughter in the second degree. Robert Law, the flagman, was indicted for violation of the company's rules.

The Elgin, Joliet & Eastern Railway has had safety committees actively at work since January, 1911, and in these 16 months the local committees have sent to headquarters over 1,200 suggestions for the promotion of safety; and all but about 75 of these have proved useful. This information appears in the last accident bulletin of the Indianapolis State Railroad Commission, which has recommended that all of the roads of the state establish safety committees, and which is making inquiries to see what the roads are doing. The Elgin, Joliet & Eastern uses stereopticon pictures and other up-to-date means of informing employees concerning every-day dangers. Bulletins are issued giving notice of important discoveries and conclusions. Cases have been found where men injured but slightly had made no report to the medical officer, with unfortunate results—in one case loss of life.

Safety committees have been organized on the New York Central Lines west of Buffalo under the supervision of Vice-president A. H. Smith. A general safety committee includes the assistants to the vice-president, the general manager of the Lake Shore, the general manager of the Big Four, the general manager of the Michigan Central, the general superintendent of the Indiana Harbor Belt, the general claims attorney and the general safety agent. As previously announced, George H. Bradshaw, assistant to the claims attorney of the New York Central & Hudson River, has been appointed general safety agent, with headquarters at Chicago, and will be secretary of the general committee. In addition, a central safety committee has been appointed for each line, including the assistant general manager, general superintendent, assistant chief engineer, superintendent of motive power, signal engineer, mechanical engineer, inspector of freight transportation and chief claim agent. Division safety committees have also been appointed and shop committees will be appointed at the larger shops. The central division and shop committees will meet at least once a month.

The Chicago & Western Indiana and the Belt Railway of Chicago have recently organized safety committees, following the plan that has been put into effect on many other roads, but with a slightly different method of organization. The safety committee plan was explained at a mass meeting of the employees by officers of the company and the members of the central safety committee were nominated and elected directly by the employees. The central safety committee consists of the following: C. G. Austin, general attorney, chairman; E. H. Lee, chief engineer; R. W. Stevens, superintendent; F. E. Jacob, signal engineer; E. L. Pollock, purchasing agent; G. M. Grimes, claim agent, and L. M. Betts, car accountant, who is secretary of the committee. The plan also includes five district committees, also elected directly by the employees, except that the chairmen were appointed by the central committee, and they comprise a division committee. The lines of the Western Indiana and of the Belt were divided into five districts, and the district committees were elected by ballot by members of the various crafts, according to a plan which insured that the different crafts would be properly represented on the committees. The district and the division committees will hold meetings once a month and make recommendations to the central committee which will also meet once a month following the meeting of the other committees. An attractive button is being prepared to be worn by members of the committee. It will be in the form of the company's trade mark, and will contain the motto "Safety Always First."

WAGES AND EARNINGS ON THE PENNSYLVANIA

While the strike vote was being taken by the eastern enginemen, the Pennsylvania distributed among employees in train service on its Lines East a statement as to wages and earnings from which the following is extracted:

In 1890 for every dollar earned, the Pennsylvania Railroad paid to its employees 44.8 cents; in 1911, 51.7 cents. In 1890 the average annual earnings of the employees were $570.37; in 1911, $800.29. The employees, therefore, today are receiving 39 per cent. more than in 1890, and 15.4 per cent. more on every dollar earned than in 1890. In 1911 the enginemen received 16 per cent. more on every dollar of gross earnings than they did in 1890. The average annual earnings of all P. R. R. enginemen in 1890 were $1,114.71; in 1911, $1,546.34, an increase of 39 per cent. In addition to this, many of these enginemen earned wages as firemen. In 1890 the same enginemen on full time basis earned $1,130.54, while on the same basis in 1911 the average was $1,741.42, an increase of 54 per cent. Excluding the Pennsylvania Railroad, the increase asked for by the enginemen amounts to 20.2 per cent. for all lines interested, whereas its effect on the P. R. R. alone would be 11.8 per cent. increase, evidencing the fact that its own enginemen are now receiving nearly 8.5 per cent. more than the average wage paid enginemen on the other roads interested.

The Pennsylvania Railroad stockholder in 1890 received a dividend of 5.5 per cent. on the face value of his stock; in 1911 he received 6 per cent.; therefore, the stockholder who bought his stock in 1890 at the average market price of $51.50 per share and continued to own his stock and allotments in addition to cash dividends would have received on his investment an average yearly return for the period 1890 to 1911 of 5.4 per cent., or practically no increase. It is apparent, therefore, that the stockholders have not profited with employees in the growth of the company. In the 1908 depression they sustained a reduction of over 14 per cent. in their dividends, while the wages of employees, then at the highest figure, remained unchanged, and in 1910 were further increased. Out of every dollar received by the company in 1890, 68.5 cents had to be spent for operation; in 1911, 78 cents. This increase in the cost of operation was due to advance in wages, increased taxation, increased cost of material and necessary items in operation and to meet legislative and public demands. Based on the 1911 operations of the company, if the 11.8 per cent. increase asked for by the P. R. R. enginemen were granted to all employees, it would entirely wipe out the surplus, necessitating the curtailing of improvements and reducing the dividends paid stockholders, and leaving the company no margin of surplus to protect its financial credit.

MEETINGS AND CONVENTIONS

International Railway Congress.—The permanent commission of the International Railway Congress, which will hold its next meeting at Berlin, Germany, in 1915, has, on the recommendation of the American members of the commission, designated the following as the American reporters on the subjects mentioned:

	Subjects.	Reporters.
	First Section.	
I.	Method of construction of readbed and track, etc.	H. U. Mudge, President, Rock Island Lines.
II.	Study of maintenance and supervision of track.	Epes Randolph, President, Southern Pacific in Mexico.
III.	Special steels.	W. C. Cushing, C. E. M. of W., Pennsylvania Lines.
IV.	Reinforced concrete.	C. H. Cartlidge, Bridge Engr., C. B. & Q.
	Second Section.	
VII.	Passenger equipment.	B. F. Bush, President, Missouri Pacific Ry.
VIII.	Electric traction.	Horace G. Burt, Chief Engr., Chicago Committee of Investigation on Electrification of Railway Terminals.
	Third Section.	
IX.	Passenger terminals.	F. A. Delano, Receiver, Wabash Railroad.
X.	Freight terminals.	W. S. Kinnear, President, Kansas City Terminal Co.
	Fourth Section.	
XIII.	The relation of cost of service to rates.	Fairfax Harrison, President, C. I. & L.
XV.	Interchange of equipment and demurrage charges.	Arthur Hale, General Agent, American Railway Association.
XVI.	Workmen's dwellings.	A. F. Banks, President, E. J. & E.
	Fifth Section.	
XIX.	Special types of traction units for branch lines.	H. B. Spencer, Vice-President, Southern Ry.

The American members of the permanent commission of the Congress are the following: W. F. Allen, general secretary, American Railway Association; E. P. Ripley, president, A. T. & S. F.; Theodore N. Ely, Bryn Mawr, Pa.; Fairfax Harrison, president, C. I. & L.; Charles M. Hays (deceased), president, Grand Trunk; Franklin K. Lane, Interstate Commerce Commission; L. F. Loree, president, C. & O.; Stuyvesant Fish, 52 Wall street, New York; W. W. Finley, president, Southern Railway.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass. 1913 convention to be held at St. Louis, Mo.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—M. H. Bray, N. Y., N. H. & H., New Haven, Conn. Convention, Sherman Hotel, Chicago, July 9.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. 39th St., New York.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North 50th Court, Chicago; 2d Monday in month, Chicago.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—D. B. Sebastian, La Salle St. Station, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—L. H. Bryan, Brown Marx building, Birmingham, Ala. Convention at Sherman Hotel, Chicago, July 23-26, 1912.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio. Convention, August 20, Chicago.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass. Convention, September 10-13, Albany Hotel, Denver, Col.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y. Convention, August 27-30, Sherman Hotel, Chicago.

PERSONALS

GENERAL.

GLENN WARNER has been appointed fuel inspector of the Pere Marquette, with office at Detroit, Mich.

J. F. GOODRICH has been appointed assistant superintendent of the Arizona Eastern, with office at Phoenix, Ariz.

J. J. CAREY has been appointed master mechanic of the Baltimore & Ohio Southwestern at Washington, Ind., succeeding C. A. Gill.

W. L. DAVIS, formerly apprentice instructor of the Atchison, Topeka & Santa Fe, at Topeka, Kan., is now night enginehouse foreman at 18th street, Chicago.

PETER MCQUAID, engine house foreman of the Prince Edward Island Railway, has been appointed master mechanic, with office at Charlottetown, Prince Edward Island.

T. J. BURNS, whose appointment as assistant superintendent of motive power of the Michigan Central, with office at Detroit, Mich., was announced in the June *American Engineer*, was born July 24, 1869, at Hillsdale, Mich. He is a graduate of the Bay City, Mich., high school and of Assumption College at Sandwich, Ont., and he took a post-graduate course at Grand Seminaire, Montreal, Que. He began railway work with the Michigan Central at Bay City, Mich., and after working one year in the track department he entered the locomotive and car department. In 1902 he was made chief clerk of the locomotive department at Jackson, Mich., and three years later was transferred to Detroit as chief clerk of the locomotive and car department. He was appointed assistant to the superintendent of motive power in 1909, which title he held until his recent promotion to assistant superintendent of motive power.

T. J. Burns.

J. E. TIERNEY has been appointed master mechanic of the Louisiana & Arkansas, with office at Stamps, Ark., succeeding A. J. Wade, resigned on account of ill health.

J. P. MCMURRAY has been appointed master mechanic of the Rio Grande division of the Atchison, Topeka & Santa Fe, with headquarters at Albuquerque, N. M., vice L. A. Mattimore.

HENRY W. JACOBS, assistant superintendent of motive power of the Atchison, Topeka & Santa Fe system, with office at Topeka, Kan., has resigned, and will devote his time to private affairs.

J. R. GOULD, superintendent of motive power of the Virginia general division of the Chesapeake & Ohio, has been appointed general superintendent of motive power, vice J. F. Walsh, resigned.

J. C. MORRISON, road foreman of the Chicago, Burlington & Quincy at Lincoln, Neb., has been appointed master mechanic of the Omaha division, with office at Omaha, Neb., succeeding A. N. Willsie, who has been appointed chairman of the company's fuel committee at Chicago.

JAMES F. WALSH, general superintendent of motive power of the Chesapeake & Ohio, with office at Richmond, Va., has retired from the active duties of that office. He may continue with the road in a consulting capacity. Mr. Walsh was born in March, 1857, at Cleveland, Ohio, and began railway work in 1871, on the Cleveland, Columbus, Cincinnati & Indianapolis, now a part of the Cleveland, Cincinnati, Chicago & St. Louis. From 1871 to 1892 he was consecutively apprentice, locomotive fireman, locomotive engineman, and shop foreman. Mr. Walsh left railway work in 1892 to become mechanical expert for the Galena Oil Company, but returned to the railway service ten years later as superintendent of motive power on the Chesapeake & Ohio. He held the position until May, 1910, when he was promoted to general superintendent of motive power. An important work which has been carried on during the past few years under Mr. Walsh's direction was the introduction of the Mountain type, Mikado and Mallet locomotives, which have received frequent mention in our columns.

J. F. Walsh.

SAMUEL GARVER THOMSON has been appointed superintendent of motive power and rolling equipment, of the Philadelphia & Reading, with headquarters at Reading, Pa. Mr. Thomson was born on November 19, 1875, at Cumberland, Md., and was graduated from the Lawrenceville school in 1894, and from Princeton University in 1898. In October of the same year he began railway work on the Pennsylvania Railroad as special apprentice at the Altoona, Pa., shops, and he completed his apprenticeship in 1902. The following year he was general foreman of the Bedford shops at State Line, and in November, 1904, he was assistant master mechanic of the Harrisburg shops. Mr. Thomson was appointed assistant engineer of motive power of the Buffalo & Allegheny Valley division, now the Northern division, with headquarters at Buffalo, in February, 1906, and in April, 1908, was transferred in the same capacity to the office of the assistant to the general manager at Philadelphia, Pa., of the same road. He went to the Philadelphia & Reading as assistant engineer of motive power on November 15, 1909, and in January, 1912, was made acting superintendent of motive power and rolling equipment of the same company, which position he held at the time of his recent appointment as superintendent of motive power and rolling equipment, as above noted.

S. G. Thomson.

CHARLES A. GILL, master mechanic of the Baltimore & Ohio Southwestern, at Washington, Ind., has been transferred to the Cincinnati, Hamilton & Dayton at Cincinnati, Ohio, succeeding W. G. Rose.

W. G. ROSE, master mechanic of the Cincinnati, Hamilton & Dayton, at Cincinnati, Ohio, has been appointed master mechanic of the Moorefield shops, near Minneapolis, succeeding W. C. Steers, resigned.

FRANK RUSCH, district master mechanic of the Chicago, Milwaukee & Puget Sound at Tacoma, Wash., has been appointed acting general master mechanic, with office at Tacoma, succeeding N. M. Maine, deceased.

J. R. SEXTON, master mechanic of the Missouri division of the Atchison, Topeka & Santa Fe, has been promoted to mechanical superintendent of the Northern district of the Western lines, with headquarters at La Junta, Col.

M. J. DRURY, mechanical superintendent of the Northern division of the Western lines of the Atchison, Topeka & Santa Fe, has been appointed superintendent of shops, with office at Topeka, Kan. He was born May 24, 1849, at Berkenhead, Eng., and and came to this country with his parents when he was three years old, and received a common school education at Parkersburg, W. Va. In 1886 he entered a contract shop as a machinist apprentice, and in 1870 began railway work with the Baltimore & Ohio at Grafton, W. Va., with which company he remained for ten years, working at Grafton and Newark, Ohio, and at Chicago. He then went to the Missouri, Kansas & Texas as a machinist at Parsons, Kan., and was later gang foreman. In 1887 he went with the Lake Shore & Michigan Southern at Elkhart, Ind., as a machinist, and the next year went to the Denver & Rio Grande as night foreman. On February 1, 1889, he went with the Atchison, Topeka & Santa Fe, with which road he has been ever since. He was consecutively machinist, gang foreman, general foreman, first at La Junta, Colo., and later at Arkansas City, Kan., and division foreman on the Oklahoma division at Arkansas City. He was appointed master mechanic at Winslow, Ariz., in October, 1902, and was transferred with the same title to Raton, N. Mex., in May, 1906. On November 1, 1906, he was appointed mechanical superintendent of the Western lines, with headquarters at La Junta, from which position he was recently promoted to superintendent of shops.

M. J. Drury.

E. H. RAQUET, chief chemist of the New York, New Haven & Hartford, at New Haven, Conn., has been appointed engineer of tests of the New York, New Haven & Hartford, the Boston & Maine, and the Central New England, with office at Boston, Mass., vice M. C. M. Hatch, resigned.

F. L. CARSON has been appointed master mechanic of the Chicago Great Western at Des Moines, Iowa, vice A. J. Isaacks. Mr. Carson was formerly connected with the Atchison, Topeka & Santa Fe, the Gulf, Colorado & Santa Fe, El Paso & Southwestern, Mexican Central and the National Lines of Mexico, and comes to his new position from San Antonio, Tex.

SHOP

H. A. Keswich, shop foreman of the Canadian Pacific at Kamloops, B. C., has resigned.

R. R. Neild, general foreman of the Canadian Pacific at the Winnipeg shops, has resigned.

J. H. Jackson has been appointed locomotive foreman of the Canadian Pacific at Rogers Pass, B. C.

Elmer Blinn, apprentice instructor of the Atchison, Topeka & Santa Fe, at La Junta, Col., has been transferred to Topeka, Kan.

H. W. Hinman, apprentice instructor of the Atchison, Topeka & Santa Fe, has been transferred to Topeka, Kan., from Clovis, N. M.

A. Sturrock has been appointed acting locomotive foreman of the Canadian Pacific at Ft. William, Ont., vice J. McArthur, who is seriouslly ill.

C. P. Lyle has been appointed division foreman of the St. Louis & San Francisco at Hugo, Okla., vice J. L. Harvey, transferred to Fort Worth, Tex.

D. G. McDonald has been appointed acting locomotive foreman of the Canadian Pacific at Red Deer, Alberta, vice J. A. Doig, assigned to other duties.

OBITUARY

W. K. High, formerly master mechanic of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Mattoon, Ill., died at Mattoon on June 22. Mr. High was placed on the pension roll of the company last November.

David Holtz, formerly for over 30 years master of machinery of the Western Maryland, died on May 30, at Baltimore, Md. Mr. Holtz was born on November 15, 1842, at Baltimore, and began railway work in 1856. He was consecutively messenger boy, clerk, apprentice in machine shops and draftsman on the Baltimore & Ohio, and then for 15 months he was assistant engineer in the United States Navy. The following eight years he was chief draftsman of the Baltimore & Ohio, and for one year from September, 1873, was superintendent of rolling stock of the New York, Lake Erie & Western. In 1874 he returned to the Baltimore & Ohio as draftsman, and in November, 1876, was appointed master of machinery on the Western Maryland, from which position he resigned in June, 1907.

New R. R. Y. M. C. A.—The Railroad Young Men's Christian Association at Forty-ninth street and Madison avenue, New York City, adjacent to the Grand Central Terminal, whose beautiful building at that point was given to the association by the late Cornelius Vanderbilt, is to have a large new building, three blocks north and one block east of its present location; and the $500,000 necessary for the purpose has already been subscribed. The land at the new location is given by the New York Central & Hudson River. It is bounded on the east by Park avenue, on the south by Forty-ninth street and on the north by Fiftieth street; and its depth west from Park avenue is 67 ft. The new building will be six stories high and will have about 70,000 sq. ft. of floor space. It will be the most elaborate institution of the kind in the country, and probably in the world, and will have 250 sleeping rooms. The walls will be of white brick trimmed with white granite. Park avenue, running north and south above the track of the approach to the Grand Central Terminal and extending southward through the center of the yard to the station building at Forty-fifth street, will be one of the most beautiful streets in the city. It is understood that members of the Vanderbilt family are large subscribers to the building fund.

NEW SHOPS

Boston & Maine.—The $3,000,000 shops at North Billerica, Mass., have progressed to a point where the contract for the concrete piling and capping has been let. The ten shop buildings will cover about 150 acres. Bids are being prepared for the new machine tools.

Chicago, St. Paul, Minneapolis & Omaha.—The contract for the construction of an engine house at Minneapolis, Minn., has been awarded. The cost is estimated at $150,000.

Chicago & North Western.—It is reported that a 60-stall engine house and machine shop will be built at Green Bay, Wis.

Cleveland, Cincinnati, Chicago & St. Louis.—It is reported that the Indianapolis, Ind., yards will be enlarged and that $175,000 will be spent in erecting additional shop buildings at Beech Grove.

Elgin, Joliet & Eastern.—Bids have been received for a two-story locomotive shop, 149 ft. x 440 ft., at Joliet, Ind.

Georgia, Florida & Alabama.—The engine house, machine and other shops that were destroyed by fire at Bainbridge, Ga., May 1, will be rebuilt as soon as possible at an approximate cost of $50,000.

Michigan Central.—Work will be started at once on the construction of a large engine house and machine shop at Kalamazoo, Mich.

Michigan Central.—New car shops will be built in Bay City, Michigan.

Missouri, Kansas & Texas.—Contracts have been awarded for grading and filling at East Waco, Texas, preliminary to erecting an engine house and other terminal improvements, which will cost approximately $300,000.

Norfolk & Western.—Contracts have been let for an engine house, machine shop, store and other buildings to be built at Norfolk, Va., at a cost of $100,000.

Pennsylvania.—A new machine shop will be built at Cleveland, Ohio, on the Lake front near West Boulevard. The building will be 65 ft. wide by 70 ft. long and one story high. It will be of steel and concrete construction.

Texas & Pacific.—The yards at Westwego, Texas, will be reconstructed and an engine house and the shops will be rebuilt.

Union Pacific.—Extensive improvements are being made in the Denver, Colo., shops, which were formerly leased by the Pullman Company, so that they will be able to handle general locomotive repair work for the Colorado division, thus saving the cost of sending locomotives a long distance to other shops. It is planned to have the improvements in operation early in July, including a 10-pit machine shop, and a locomotive blacksmith and boiler shop with a capacity for making heavy and general repairs to about fifteen engines a month. About $90,000 has been expended on modern motor-driven tools arranged for group motor drive. A new modern power house equipped with water tube boilers, filters and coal and ash-handling machinery is also to be built at this point.

Wabash.—Plans for new shops at Decatur, Ill., are being considered. They will cost approximately $750,000.

Wages on the Pennsylvania.—The Pennsylvania Railroad System in the past 25 years has paid in wages $2,220,034,753, or double the amount of the national debt. The system has 11,503 miles of line, 25,236 miles of track, and about 185,000 employees.

SUPPLY TRADE NOTES

The Watson-Stillman Company, New York, will soon open a branch office in Philadelphia, Pa.

The Western Electric Company has opened a branch office and a large warehouse at Houston, Tex. The sales agent is H. P. Hess.

Frank J. Kent, patent and trade mark lawyer, has removed his office to the Metropolitan Bank building, 271 Broadway, New York.

The Pittsburgh Testing Laboratory, Pittsburgh, Pa., has opened a branch office at 204 White building, Seattle, Wash., in charge of C. A. Perkins, district manager.

A bill asking the foreclosure of the property of the Allis-Chalmers Company, Milwaukee, Wis., in Chicago, has been filed in the United States district court, by the Continental & Commercial National Bank.

R. A. Dugan, in charge of the sales department of the Chicago office of the Scullin-Gallagher Iron & Steel Company, St. Louis, Mo., has been made district manager, with office at 1049-50 McCormick building, Chicago.

Robert M. Smith has been appointed sales manager of Burton W. Mudge & Company, of Chicago. Mr. Smith was previously in New York in charge of the eastern territory of the railway department of a supply concern.

J. T. Georgeson, formerly with the machinery department of Joseph T. Ryerson & Son, Chicago, has joined the sales organization of the Vulcan Engineering Sales Company, Chicago, dealing especially with the Q. M. S. Company's products.

J. E. Chisholm has opened an office at 355 Old Colony building, Chicago, and will handle railway specialties. Mr. Chisholm has been sales manager of the Chicago Steel Car Company for the past three years, and was formerly mechanical superintendent of the Chicago Great Western.

W. A. Austin, for a number of years in the engineering department of the Baldwin Locomotive Works, Philadelphia, Pa., with office in that city, has resigned that position to go to the Lima Locomotive & Machine Company, Lima, Ohio, as chief mechanical engineer, with office at Lima.

The Lima Locomotive & Machine Company, Lima, Ohio, has sold to New York bankers, first mortgage, 6 per cent., 20-year sinking fund bonds to the amount of $2,000,000, the proceeds to be used for the construction of additional buildings, the purchase of machinery and for working capital.

The H. W. Johns-Manville Company, New York, has moved its Winnipeg, Man., offices to 92 Arthur street. This is a six-story and basement building, 50 ft. wide and 100 ft. deep, and will be occupied throughout by the company's offices and storerooms. The office force will be increased.

John S. Quist, formerly in the locomotive department of the Union Pacific, has become associated with the M. M. Rogers Company, of Chicago, maker of the Rogers improved indestructible journal packing. Mr. Quist will have charge both of the manufacturing and sales departments, and his office will be at the factory, 6422 Stony Island avenue.

The American Mason Safety Tread Company, Boston, Mass., has purchased from the Quincy, Manchester, Sargent Company, Chicago, all patents, machinery, selling rights, etc., connected with the Stanwood steel car steps and treads. The Stanwood step has been used by street, elevated and steam railways for a number of years. It is composed of a number of thin strips of steel, crimped so as to form corrugation which, when the strips are assembled, produce a series of hexagonal openings.

H. M. Estabrook was elected president of the Barney & Smith Car Company, at the annual meeting held at Dayton, Ohio, June 4. He was born in Cambridge City, Ind., in 1864, and received his education in the public schools, graduating from the Terre Haute High School in the class of 1883. He then went to Oswego, N. Y., to study stenography, and soon after became stenographer in the motive power department of the New York, West Shore & Buffalo, now the West Shore, under R. H. Soule and James M. Boone. In August, 1885, he went to Dayton, Ohio, as stenographer for the Barney & Smith Car Company. After filling various positions he was made general assistant to the superintendent, and was appointed assistant superintendent in December, 1897. In January, 1900, he was appointed superintendent, and in June, 1906, he was elected a member of the board of directors, and was also elected second vice-president and general superintendent. On November 10, 1908, he was elected vice-president and general superintendent, and now becomes president of the company. Arthur J. Stevens, who was also elected first vice-president and general manager, has been in charge of the lumber department of that company for the last four years, having been appointed manager April 1, 1908. On October 21, 1909, Mr. Stevens was appointed manager of purchases and transportation, which included the purchase of all materials and lumber and transportation, including all inbound and outbound shipments; and in June of the following year he was elected to the board of directors and also second vice-president. Mr. Stevens was born on May 23, 1871, at Dayton, Ohio. He received his early education in the public schools and at Cooper Seminary in Dayton, which was founded about the year 1834 by Eliam E. Barney, the founder of the Barney & Smith Car Company. After finishing his course at the seminary he took a college course at Denison University, at Granville, Ohio, and after leaving college he entered the lumber business. He entered the service of the Barney & Smith Car Company as assistant lumber buyer on December 26, 1897; later when he was appointed manager he succeeded his father, James H. Stevens, who retired after a continuous service with the car company of over 46 years. In March, 1905, the company having bought large timber interests, including a saw-mill and railway in southern Georgia, there was organized

H. M. Estabrook.

A. J. Stevens.

the Milltown Lumber Company, Milltown, Ga., and the Milltown Air Line Railroad, of both of which companies Mr Stevens was elected president, which offices he now holds. Mr. Stevens was a grandson of Ansel E. Stevens, who was with the car company in its earliest years, having entered its service in 1852. He was associated with the elder Mr. Barney in the early days of the company, and continued in its service until 1882. Mr. Stevens' grandmother, Mrs. Ansel E. Stevens, was a sister of E. E. Barney, founder of the car company, and his father, J. H. Stevens, and his grandfather, A. E. Stevens, have given to the car company an aggregate service of over 90 years, having had complete charge of its very extensive lumber interests since the founding of the company. Under the direction of Mr. Stevens, the car company has become an importer direct of fancy woods from all parts of the world. The following officers were also elected at the annual meeting: Second vice-president and treasurer, J. F. Kiefaber; secretary and assistant treasurer, E. A. Oblinger; assistant secretary, E. H. Sines; and directors, Walter St. J. Jones, J. Rawson, John L. Lincoln and John M. Wright, Cincinnati, and Eugene J. Barney, E. Frank Platt, H. M. Estabrook, A. J. Stevens and J. F. Kiefaber, Dayton.

The Cincinnati Locomotive & Car Works has been incorporated in Ohio with a capitalization of $25,000, to make and repair locomotives, cars, machinery and general railway equipment at Cincinnati. The incorporators are John Glenn, of Ludlow, Ohio, and William Edwards and Daniel Goldstein, of Cincinnati. The plant will soon be moved to Covington, Ky.

Major Eli H. Janney, inventor of the Janney car coupler, died at his home in Alexandria, Va., June 17, in his eightieth year. Major Janney was a field quartermaster on the staff of General Robert E. Lee in the civil war. The contour lines of the Janney coupler were adopted by the Master Car Builders' Association, and thus are now the well-known "M. C. B. standard," used everywhere throughout the United States.

The Eastern Car Company, recently incorporated with a capitalization of $2,500,000 as a subsidiary of the Nova Scotia Steel & Coal Company, advises that its intention is to erect a modern steel freight car plant at New Glasgow, N. S., with a cacapacity of 25 cars a day. Plans are now being prepared, and it is expected that the work will be commenced within two weeks. From 800 to 1,000 men will be employed. The plant will be located immediately adjoining the mills of the Nova Scotia Steel & Coal Company.

The M-C-B Company has been organized under the laws of Illinois to make and deal in railway supplies, with the following officers and stockholders: President, Walter E. Marvel; vice-president, Frank A. Buckley; secretary and treasurer, Erle C. Cowgill. Mr. Marvel was for several years manager of the St. Louis branch of the Buda Company, Chicago, and later western sales manager of the Detroit Seamless Steel Tubes Company, Detroit, Mich. Mr. Cowgill was assistant to President Markham of the Illinois Central. Mr. Buckley is western superintendent of the Armspear Company, New York, and the Central Railway Signal Company of Pittsburgh. The new company derives its name from the first letters of the surnames of its officers and stockholders. The Chicago offices will be located in the McCormick building. The M-C-B Company, in addition to making several of its own patented devices, has secured the exclusive sole rights in western territory from some of the foremost manufacturers of the following lines: Miscellaneous cars for traction lines; snow plows, flangers, sweepers and ice diggers for steam and electric lines; pneumatic tools for railway shop work; track and bonding drills, tool grinders, cattle guards, jacks, handmade chains, locomotive water gages, track tools, anti-rail creepers, portable kerosene lights, etc. The Russell Car & Snow Plow Company, Ridgway, Pa., has appointed the M-C-B Company its exclusive agent in western territory.

CATALOGS

Radial Drills.—The Fosdick Machine Tool Company, Cincinnati, Ohio, has issued two folders describing their 4 ft. and 5 ft. National radial drills. A brief description and specifications are included in these folders.

Air Compressors.—The Chicago Pneumatic Tool Company, Chicago, has issued a pamphlet, form No. 90, illustrating and describing its single and duplex compressors, which may be driven by steam, belt or electricity.

Water Tube Boilers.—Egbert R. Morrison, Sharon, Pa., has published a pamphlet on Morrison Water Tube Boilers, containing diagrams, brief descriptions and reasons why these boilers are safe, economical and efficient.

Shaft Hangers.—The Hess-Bright Manufacturing Company, Philadelphia, Pa., has issued a 32-page catalog describing its ball-bearing hangers. Illustrations are included showing the various types of hangers, and accompanying tables give their general dimensions.

Volt-Ammeter.—The General Electric Company, Schenectady, N. Y., has issued bulletin No. 4880 describing its type *S-2* signal volt-ammeter. This instrument is used for testing direct single current apparatus and is arranged for six combinations, giving three volt and three current ranges.

Brake Beams.—The Damascus Brake Beam Company, Cleveland, Ohio, has issued a 78-page illustrated catalog, including drawings and photographs of, and descriptive data and specifications regarding, the Waycott Special, Anglrod and Damascus brake beams, the Brascott freight car ladder and miscellaneous appliances.

Oil Filtration.—S. F. Bowser & Co., Ft. Wayne, Ind., have published an illustrated booklet entitled Oil Filtration and Circulating Systems. This booklet contains detailed descriptions of these systems amplified by diagrams. Accessories are also illustrated and described. The booklet ends with 17 advantages of these systems.

Alcohol Heater Cars.—The Alcohol Heating & Lighting Company, Chicago, has issued a pamphlet describing and illustrating the use of alcohol heaters in warming freight cars carrying perishable freight. The burners are provided with automatic control and each car has a capacity for 24 gals. of alcohol, which will keep one burner going continuously for eight 24-hour days.

Electric Railway Systems.—The General Electric Company, Schenectady, N. Y., has recently issued bulletin No. 4950, which describes the Washington, Baltimore & Annapolis 1,200 volt d. c. electric railway. Illustrations are given of the various installations and wiring diagrams used on this road; data concerning the operating expenses and power production are also given.

Steel Valves and Fittings.—The Nelson Valve Company, Philadelphia, Pa., has issued catalog *S* describing the Nelson steel valves and fittings. Illustrations are given showing various operations in the process of manufacture, as well as the different types and sizes of valves, with an accompanying price list. This company handles all kinds of valves and fittings and the catalog includes the general sizes up to that for 24 in. pipe.

Graphite.—The Joseph Dixon Crucible Company, Jersey City, N. J., has issued a 40-page booklet entitled Graphite Products for the Railroad, giving illustrations and descriptions of methods of using Dixon graphite products in maintenance of equipment work. This is the second edition of the book brought up to date to correspond with certain changes that have been made in standard practice and several new products that have been added to the line.